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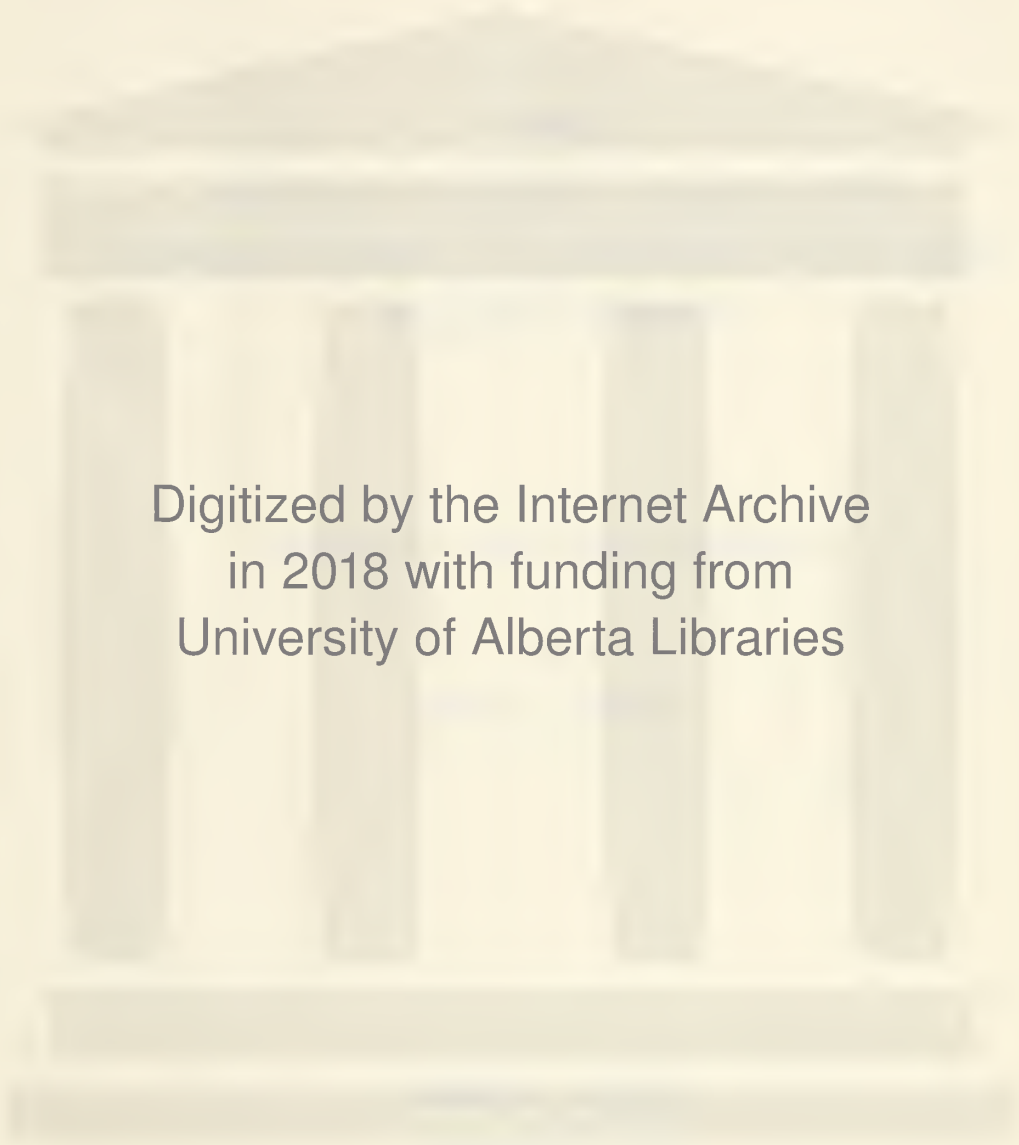
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# THE SYSTEMATIC DEVELOPMENT OF A PROGRAM OF EXTRACURRICULAR ACTIVITIES IN SCIENCE

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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by

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## ABSTRACT

A great need for better planning of extracurricular activities is emphasized by both local and general literature on the subject. The writer was particularly concerned with the difficulty of finding a sound basis on which to plan extracurricular activities in science.

This study attempted scientific development of a science club program. It proposed to take systematic steps, planned according to the best information available, in order to develop an optimum program of extracurricular activities in science for the Strathcona Composite High School science club.

The plan for development was based on the following five steps:

A. List all extracurricular activities of possible value to the science club.

B. Establish objectives for the science club program.

C. Use the objectives as criteria in the selection of activities to be promoted.

D. Promote the selected activities during one year of science club operation.

E. Make a final evaluation of the objectives and activities.

The importance of continuous evaluation which served as a guide to development became more apparent as the study progressed.

The carrying out of the plan resulted in a program of activities which was generally very satisfactory in the opinion of those concerned. Findings tended to support the suitability of the objectives which were established for the science club program but indicated the desirability

of certain modifications of them. There was evidence that student science projects, special physics lectures by university professors, and an educational program at the Research Council of Alberta were the three activities highest in educational value and in student preference. Other activities were found to be essential to a balanced program designed to achieve the objectives established.

Though this study did not yield highly objective evidence regarding the values of extracurricular activities in science, it is hoped that it will stimulate effort in that direction by promoting well planned activities for which useful data is recorded.

It is expected that this study will contribute to the development of better extracurricular programs in science by encouraging the improvement of promising activities by means of continuous evaluation and redirection.

TABLE OF CONTENTS


| CHAPTER | | PAGE |
|---|---|---|
| I. | THE PROBLEM | 1 |
| | Statement of the Problem | 1 |
| | Definitions of Terms Used | 1 |
| | Extracurricular activities | 1 |
| | Development of an optimum program | 1 |
| | The Strathcona Composite High School Science Club | 2 |
| | Origin of the Problem and Need for the Study | 2 |
| | The Basic Hypothesis | 4 |
| | The Basic Assumption | 4 |
| | Subproblems | 4 |
| | Scope and Limitations | 5 |
| II. | RELATED LITERATURE | 6 |
| | Literature Pertaining to Science Club Objectives | 6 |
| | Literature Pertaining to Science Club Organization | 7 |
| | Accounts of Activities in Science | 8 |
| | Resource material | 9 |
| | The Berg Plan | 10 |
| | The Horace Mann Science Program | 12 |
| | Other plans and programs | 12 |
| | Literature Pertaining to the Evaluation Problem | 13 |

CHAPTER PAGE

III. THE DESIGN ..... 17

Compilation of list of extracurricular activities... 17

Establishment of the objectives of extracurricular activities ..... 18

Selection of activities to be promoted ..... 18

Promotion of the selected activities ..... 18

Final evaluation ..... 19

IV. OBJECTIVES OF THE SCIENCE CLUB ..... 21

Objectives of the Science Club ..... 26

V. PRE-ACTIVITY PLANNING OF THE SCIENCE CLUB PROGRAM ..... 27

Policies followed ..... 27

Organization of the Science Club ..... 29

Assistance for the Science Club ..... 29

Planning Activities ..... 29

VI. DESCRIPTION OF SCIENCE CLUB ACTIVITIES CARRIED ON DURING THE SCHOOL YEAR 1959-60 ..... 40

Projects ..... 41

Field trips ..... 42

Films ..... 43

Science fair ..... 43

Reading shelf ..... 43

Special physics lectures ..... 43

Research Council program ..... 44

Laboratory assistants ..... 44

Business meetings ..... 44

CHAPTER PAGE

VII EVALUATION PROCEDURES ..... 46

Procedures Used to Evaluate Objectives of the Science Club ..... 46

Procedures Used to Determine Relative Educational Values of the Nine Kinds of Activities Engaged in ..... 47

Procedures Used in Evaluating the Alberta Research Council Educational Program ..... 52

Procedures Used in Evaluating the Special Physics Lectures ..... 52

Procedures Used in Evaluating the Program of Extra-curricular Activities in Science as a Whole ..... 53

Evaluation Instruments ..... 54

Validity and Reliability of Instruments ..... 55

VIII. SUMMARY OF FINDINGS ..... 57

Findings Relating to Objectives of the Science Club .. 57

Findings Relating to Relative Values of Activities ... 61

Findings Relating to the Research Council of Alberta Educational Program ..... 64

Findings Relating to the Special Physics Lectures at the University of Alberta ..... 67

Findings Concerning the Program of Extracurricular Activities as a Whole ..... 68

Some Indications of Scholastic Ability and Achievement of Participating Pupils ..... 70

Findings Regarding some Particular Activities and some Features of Science Club Organization ..... 71

CHAPTER PAGE

IX. CONCLUSIONS AND RECOMMENDATIONS ..... 73

Conclusions Based on Relatively Objective Investigations ..... 73

Conclusions Based on a More Subjective Treatment of Data ..... 74

Conclusion Regarding the Basic Hypothesis..... 76

Recommendations Concerning the Operation of the Science Club of the Strathcona Composite High School ..... 77

General Recommendations ..... 79

BIBLIOGRAPHY ..... 81

APPENDIX A ..... 85

APPENDIX B ..... 87

APPENDIX C ..... 89

APPENDIX D ..... 90

APPENDIX E ..... 92

APPENDIX F ..... 94

APPENDIX G ..... 95

APPENDIX H ..... 96

APPENDIX I ..... 97

LIST OF TABLES


| TABLE | | PAGE |
|---|---|---|
| I. | Sponsor's Prediction of Contributions to the Established Objectives Likely to be Made by Proposed Activities... | 37 |
| II. | Activities Listed in Order of Estimated Educational Value Accompanied by Estimates of Difficulty of Administration | 39 |
| III. | Analysis of Educational Value of the Nine Kinds of Activities Carried On ..... | 49 |
| IV. | The Method of Determining the Rank Order of Nine Kinds of Activities According to Value as Estimated by Pupils Participating ..... | 51 |
| V. | Median Values and Quartile Deviations of Ratings Assigned to Objectives of the Science Club by Pupils and Teachers ..... | 58 |
| VI. | Rankings of the Objectives of the Science Club According to their Importance by the Science Club Sponsor, by the Teachers, and by the Pupils ..... | 60 |
| VII. | The Frequency of Placement of Objectives in the Combined Two Lowest Categories and also in the Combined Two Highest Categories by Teachers and Pupils ..... | 62 |
| VIII. | Rank Orders According to Educational Value Assigned to Nine Kinds of Activities by Sponsor's Direct Estimate, by Sponsor's Systematic Analysis, and by Pupils Who Participated in the Activities ..... | 63 |

# CHAPTER I

## THE PROBLEM

Wherever there is a curriculum there are likely to be found some extensions of it which are called extracurricular activities. Such activities arising from the study of science in Alberta high schools are extremely variable in quantity, kind, and quality. There are many important decisions to be made by teachers who guide such activities. It is difficult to find a sound basis on which to make many of these decisions.

### I. STATEMENT OF THE PROBLEM

The problem was to develop an optimum program of extracurricular activities for the Strathcona Composite High School Science Club.

### II. DEFINITIONS OF TERMS USED

Extracurricular activities are to be defined according to W. S. Monroe's "Encyclopedia of Educational Research," which limits them to:

> Programs and events carrying no academic credit, sponsored and organized by pupils' or students' organizations or by the educational institution, designed to entertain, instruct, and/or provide exercise of interests and abilities; subject to some measure of control by the institution.

Development of an optimum program was to involve promotion of growth of activities found through systematic evaluation during the school year 1959-60 to be of most worth. Promotion of growth of activities was to be brought about by presenting to the members of the science club opportunities to participate in activities which showed promise of

furthering the objectives of the club. These objectives were to be formulated by the author who was to be the sponsor of the science club.

Activities were to be continuously evaluated and modified in the light of new findings and according to changed opinions regarding the activities.

The Strathcona Composite High School Science Club for the school year 1959-60 was open to all Grade XI and XII students and also to Grade X students who obtained honor standing in Grade IX Science. In addition some students are referred to the science club by guidance counsellors and teachers who feel that the referred pupil has a particular need for the kind of activity the club has to offer. It was expected to have about thirty members who would be active in varying degrees and in various areas of the science club program.

## III. ORIGIN OF THE PROBLEM AND NEED FOR THE STUDY

Large high schools by their routinized procedures tend to create a need for informal activities in science. Teaching experiences have frequently impressed this need upon the mind of the author. Students are discovered in different classes who should have the opportunity of meeting together to discuss their common interests and to cooperatively promote activities which will capitalize on some of their fundamental drives for educational gain.

The apparent increase in enthusiasm for scientific pursuits seems to have created a force that needs directing. There seems to be no reason for hesitating to make the most of a favorable situation. There are probably more resources available for extracurricular activities in

science than at any time in the past.

The multitude of values claimed for extracurricular activities in science in the existing literature on the subject makes the field seem very attractive.

The extracurriculum can be the birthplace of much that later becomes curriculum content. It can provide a testing ground for new ideas, and become the means of evolving educational practices that are eventually given a place in the curriculum.

Local resources for science teaching need to be discovered, sampled, and assessed. Activity involving field trips, visiting speakers, special lectures, films, library facilities, and individual and group science projects can be investigated more freely in the science club than in the class. Resources in the above areas should be made known to the teachers who can use them.

Comparative evaluation should be made of the several kinds of activities that can be carried on extracurricularly. It is desirable that an analytical approach be taken to prevent mere drifting into that which is easiest and most pleasant. Disregard for educational value could result from too much attention to popular demand. Even in the face of a dearth of means of objective evaluation of each activity, the question of value must be raised and the best possible answer found.

A basis should be laid for more objective evaluation of the outcomes of extracurricular activities in science. A study which points out more clearly those things that need to be measured contributes toward this end.

The establishment of objectives of extracurricular activities in science and the classification of the means of achieving these objectives will show what needs to be measured.

The challenging problems of measurement are then more likely to be investigated.

## IV. THE BASIC HYPOTHESIS

The basic hypothesis was that a carefully planned program of extracurricular activities in science for students of the Strathcona Composite High School will have enough educational value to warrant its continuation.

The design for the investigation of this hypothesis will be found in Chapter III of this thesis.

## V. THE BASIC ASSUMPTION

An assumption made at the beginning was that systematic organization and evaluation would reveal the worth of extracurricular activities that are made accessible to the students.

## VI. SUBPROBLEMS

The main problem was resolved into two subproblems. The first was to decide what the science club should try to achieve. The second was to measure its achievement continuously, or at least as frequently as possible in order to direct efforts according to the best information available.

It was evident from the start that there were so many measurements of achievement necessary that they could not all be investigated thoroughly

in a study of the length proposed. However, it was realized that this thesis would have little value if it did not make objectivity its keynote and strive for reliability and validity in every measurement undertaken.

The efforts to solve these problems were expected to provide a better basis for the development of science clubs.

## VII. SCOPE AND LIMITATIONS

This study intends to determine the purposes that should be served by the science club undergoing development. It aims to discover suitable activities through which these purposes can be achieved. It aims to develop means of evaluation that will facilitate improvement of the science club program.

This study does not intend to test by experience every science activity that seems to hold promise, nor does it expect to achieve rigorous evaluation of activities by methods that are independent of opinion. It tries out some systematically selected activities and seeks to provide a basis for continuous improvement based on increasingly better evidence.

# CHAPTER II

## RELATED LITERATURE

There is a very extensive body of literature with some bearing on the problems faced in this thesis. Almost every issue of School Science and Mathematics,[1] The Science Teacher,[2] and Science World[3] contains something relevant to the study. Other literature referred to will be mainly that which summarizes the content of the many sources or that which deals with the local situation.

### I. LITERATURE PERTAINING TO SCIENCE CLUB OBJECTIVES

Among the many statements regarding the desirability of clearly established objectives for school organizations such as science clubs there is one that is outstanding because it is very recent and applies to the local scene and to the type of school with which this study is concerned. It is the following statement.

> A final recommendation is expected to carry as much weight as all the other suggestions combined. And this is natural, since the foregoing recommendations will be of little avail without the implementation of suggestions which now follow.

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[1] School Science and Mathematics, by the Central Association of Science and Mathematics Teachers, Inc., Menasha, Wisconsin.

[2] The Science Teacher, Journal of the National Science Teachers Association, Washington, D.C.

[3] Science World, Scholastic Magazines, Inc., Dayton, Ohio.

> Administrators need to take time to analyze exactly what they are attempting to do in the field of extracurricular activities. Objectives must be formulated; planning, coordinating, organizing, directing--all the aspects of sound administration need to be implemented in setting up the structure in which the program will work; and the efforts so expended must periodically be gauged to determine how successfully the aims are being realized. Until a school staff has a clear conception of where it is going, it can never determine whether the goal has been reached. The move toward analysis of values which could accrue from extracurricular activities, the formulation of objectives, the evaluation of progress--these seem to be basic steps which may lead the composite high schools' retreat from haphazardness in this field of administration.[4]

As the most emphasized recommendation following the study from which it results, the above quotation indicates what needs to be done. It is the aim of the present study to begin doing it.

The sources used in actual development of objectives for the science club were related to the task in such a way that it was found desirable to introduce them in Chapter IV where the part played by each is fully explained.

## II. LITERATURE PERTAINING TO SCIENCE CLUB ORGANIZATION

Every reference on extracurricular activities has some pertinent suggestions regarding club organization which can be integrated with the club sponsor's experience and adapted to his use. It is useless to generalize extensively regarding the details of organization because of the wide variety of situations in which clubs have to operate. The following prophecy was thought to deserve consideration in connection

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[4]Arthur Kratzmann, A Descriptive Survey of the Extracurricular Programs of the Composite High Schools of Alberta (An unpublished thesis at the University of Alberta, 1958), p. 91.

with this thesis.

> We are willing to go on record as making the prophecy that within a short time--say five or ten years-- in the modern school, with the exception of recreational, service, and honoring clubs, there will be no such activity as an organized school club; that these "club" activities will exist and be more highly developed than ever, but that they will have been accepted and incorporated in the regular work of the classroom.[5]

It seems that if the prophecy comes true the usefulness of the study being undertaken here will not be reduced provided that it prepares for changes to come. Certainly attention must be given to trends and desirable changes in organization but the prior need in this study was for an organization to serve here and now.

The most suitable organizational framework on which to build was found in a guidebook to science fairs.[6] This publication outlines a constitution for a high school science club and makes a number of recommendations regarding its operation. The constitution outlined was observed to be too highly organized to adopt in its entirety as a beginning organization but was found to be a good guide to those things that had to be considered at the planning stage.

## III. ACCOUNTS OF ACTIVITIES IN SCIENCE

The survey of the literature on activities in science that might be used in a science club program revealed two main kinds. There was that which might be considered as standard reference material compiled

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[5]H. C. McKown, Extracurricular Activities (New York: The Macmillan Company, 1952), p. 181.

[6]Arden F. Welte et al., Your Science Fair (Minneapolis: Burgess Publishing Company, 1959), pp. 13-15.

to guide teachers and to supply them with ideas and resources. There were also accounts of more venturesome plans and projects often only on trial or in the process of development.

Resource material. The writer drew much material on science activities from Richardson and Cahoon, the most comprehensive reference found in this field.[7] It supplied an abundance of proven demonstrations and projects in general science and in physics and chemistry as well as a bibliography leading to other excellent sources. In spite of the wealth of material this book presents, it does not do what this thesis attempts to do. It does not give an account of systematic development of a program of activities in science.

Richardson gave the general outline of club activities that most nearly approximated that used in this study.[8] This basic program was supplemented extensively by items from Swezey,[9] Welte,[10] Unesco Source Book for Science Teaching,[11] Student Projects,[12] Science World,[13] School

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[7] J. S. Richardson and G. P. Cahoon, Methods and Materials for Teaching General and Physical Science (New York: McGraw-Hill Book Company, 1951).

[8] John S. Richardson, Science Teaching in Secondary Schools (Englewood Cliffs, N.J.: Prentice Hall Inc.,1957), p. 212.

[9] Kenneth M. Swezey, Science Magic (New York: McGraw-Hill Book Company, 1952).

[10] Welte, op. cit.

[11] Unesco, Unesco Source Book for Science Teaching (Amsterdam, The Netherlands: Drukkerij Holland N.V., 1956).

[12] John H. Woodburn, Student Projects (Washington D.C., National Science Teachers Association, 1958).

[13] Science World, op. cit.

Science and Mathematics,[14] The Science Teacher,[15] and Scientific American.[16]

The Berg Plan. The Berg Plan for the Advancement of Science has been widely accepted since its development in 1957. The Joe Berg Foundation, a nonprofit organization, proposed that science seminars be established throughout the United States to provide extracurricular training for selected gifted students. It extends its assistance in organization of community resources to Canadian communities as well. The following quotation outlines its procedures.[17]

I. Based on all available data, the school selects from its 10th and 11th grade groups the most able and promising students interested in science and mathematics.

II. These students are invited to compete for admission to the Seminar by taking a qualifying written examination supplied by the Foundation without charge.

III. Those who score high on the examination and other data are invited, with their parents, to attend a general orientation meeting at which the Seminar program is described in detail. At this meeting the students are interviewed and the final decision on acceptance is reached.

IV. The students who are enrolled meet at the school once each week, in the evening, for a two and a half hour Seminar session.

V. The staff of instructors is derived, by invitation, from the community's qualified scientific personnel; they are responsible to the local school but render their services to the community's children at a dollar-a-year.

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[14] School Science and Mathematics, op. cit.

[15] The Science Teacher, op. cit.

[16] Scientific American, Scientific American Inc., New York, N.Y.

[17] Jacob W. Shapiro, Science Seminars (Chicago: The Joe Berg Foundation, 1712 South Michigan Ave., Chicago 16, Illinois, 1958), pp. 6-7.

VI. The activity of the Seminar embraces work and study on such topics as the nature of scientific inquiry and proof, the principles of logic and critical thinking, the canons of experimental design, the applied and theoretical methods of research, and statistical procedures; and includes the preparation of oral and written reports.

VII. In the course of mastering some of the fundamental concepts of science, each student settles upon some hypothesis (or closely related set of hypotheses) suitable for an individual, original research project.

VIII. Local industry is invited to cooperate with the Seminar by making their research facilities available to the Seminar students while they are working on their research projects.

IX. The seminar operates within the obligations of the policies and educational philosophy of the school. However, in the selection of staff personnel, in the choice and organization of instructional materials and processes, and in the acquisition and utilization of laboratory supplies and equipment, the Seminar may be self-sufficient and self-directed.

The writer felt that there were three outstanding differences between the Berg program and that desired for the science club. The Berg plan, it seemed, would take too much of the initiative and control away from the students and science teachers. It would be much more narrowly restrictive in regard to student participation, and also much less comprehensive in the variety of activity offered than a balanced program should be. Nevertheless, its great experience in doing some of the things a science club should do makes the Joe Berg Foundation an organization from which the science club sponsor can learn.

While no systematic evaluation of the work of the Foundation was yet available when this thesis was planned, increasing attention was being paid to that aspect.

The Joe Berg Foundation launched its first Canadian Pilot Science Seminar at Vancouver in October, 1959. The Vancouver School Board report

on the year's operation made in June, 1960 indicates that 25 students participated in the program assisted by 43 professional people, that a special library had been established, that 8 field trips had been made, and at least 16 students had undertaken research studies. Statements that the program had been worthwhile and that the students had derived benefit and pleasure were the only indications of evaluation found in the June report. An April report, however, summarized opinions expressed at a meeting held to consider common problems and to make plans for the following year.

It is the intention of this writer to strive for more definite evaluation procedures than are evident in the above program. The full accounts of the activities promoted by the Joe Berg Foundation are, nevertheless, valuable reading material.

The Horace Mann Science Program.[18] This summer program in science education for gifted students was developed in the Horace Mann School in New York City in 1958. Two faculty members of the school assisted 19 selected students with science projects carried on at the school during the summer holiday. The preliminary evaluation of the program displays such enthusiasm and the accounts of various achievements are so convincing that the present writer was led to think in terms of more ambitious science projects for capable students.

Other plans and programs. Tischler's experience with student

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[18]Harry H. Williams, "The Horace Mann Science Program," The Science Teacher, (March, 1959), pp. 79-84.

laboratory assistants was encouraging enough to make one want to experiment in that area.[19]

Laughlin's account of a research project with gifted students gave detail enough to give a reader a clear picture of another outstanding venture.[20]

In general, all these reports had something to contribute to this study but none of them record attempts to do what it proposes to undertake.

## IV. LITERATURE PERTAINING TO THE EVALUATION PROBLEM

The following quotation from the Encyclopedia of Educational Research reviews important background for this thesis.

> Since World War II the growth of science clubs, science fairs, and congresses, and a wide variety of programs to provide aids, awards, and scholarships has been marked. National professional organizations and the other agencies have been active in promoting interest in science and means by which both science teachers and science students could gain recognition and more tangible rewards. With the possible exception of scholarships, the effects of these various programs have been inadequately explored. Certainly it has not been conclusively demonstrated that either science clubs or science fairs contribute effectively to the achievement of the objectives of science instruction. It is not known whether they effectively motivate regular classroom work, whether they stimulate better achievement, or whether certain objectives of the school are better attained as a result of engaging in such cocurricular activities. A large number of opinions on the values of such

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[19]Morris S. Tischler, "Student Assistants--Laboratory Indispensables," The Science Teacher, (December, 1959), pp. 540-541.

[20]Ethelreda Laughlin, "A Blood Research Project With Gifted Students," The Science Teacher, (March, 1960), pp. 39-47.

participation have been published, but concrete research evidence is lacking.[21]

Two expressions of opinions of the sort the above writer seems to have had in mind are given below in order to illustrate what is found in the literature on the subject of values of science fairs.

> The major values in the science fair are two: the incentive given to students to work toward a goal--the display of tangible results of their efforts with some kind of recognition or award, and the stimulus and learning they derive from association with other students.[22]

Contrast the above statement with the detailed quotation which follows.

> The science fair movement has vast educational and scientific implications.
>
> 1. It stimulates the interests of students who have special scientific talent.
> 2. It encourages students to express themselves by using their skills and interests in science.
> 3. It identifies and encourages the scientifically gifted children.
> 4. It encourages the use and understanding of the scientific method.
> 5. It is a means for students to acquire functional knowledge of science.
> 6. It provides a means for students to become aware of the influence of science on human life and thought.
> 7. It reports to parents and to the community about one phase of the academic performance of students.[23]

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[21]H. A. Smith and K. E. Anderson, (ed. Chester W. Harris) Encyclopedia of Educational Research, (New York: The Macmillan Company, 1960), p. 1223.

[22]John S. Richardson, Science Teaching in Secondary Schools (Englewood Cliffs, N.J.: Prentice Hall Inc., 1957), p. 213.

[23]Arden F. Welte et al., Your Science Fair (Minneapolis: Burgess Publishing Company, 1959), p. 1.

Similar claims are commonly made for other activities in science. Even though these claims of value are not supported by concrete evidence they at least indicate that purpose and direction are being considered. It is the intent of this thesis to analyze objectives and their achievement more carefully than they are treated in the literature referred to above.

The following statement summarizes the somewhat unsatisfactory efforts of the past.

> Earlier approaches to the evaluation of student activities tended to be concerned with direct measurement of values peculiar to individual activities through tests, case studies, and controlled experiment. Illustrative of these early studies were the rather frequent analyses of success in student activities in comparison with success in the classroom. There appear to have been few such studies in recent years, perhaps because there is more general acceptance of the activities program.[24]

General acceptance of the program is not a good excuse for laxity in its evaluation. The literature indicates that determining values of extracurricular activities has proven very difficult, but that does not justify avoidance of this important step.

The literature referred to so far does little more than identify the problem of evaluation. It remains to discuss that which contributed more directly to the solution attempted in this thesis.

A concept of evaluation discussed by Tyler in relation to curriculum and instruction,[25] and further expounded by MacArthur in such a way as to

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[24]Roland C. Faunce, (ed. Chester W. Harris) Encyclopedia of Educational Research (New York: The Macmillan Company, 1960), p. 510.

[25]Ralph W. Tyler, Basic Principles of Curriculum and Instruction (Chicago: The University of Chicago Press, 1950).

reveal its merit and applicability,[26] was the one adopted for this study. This concept of evaluation includes research in its process. Research seems to be required in the evaluation process used in the development of a program for a science club as there was no pattern to follow much of the way. In many cases it was impossible to achieve the rigor characteristic of research, but the guiding concept encouraged the use of research methods as far as they could be applied in these areas.

Still in agreement with the adopted concept, evaluation was the means of obtaining the best possible basis for decisions that had to be made during the developmental process. This implies a clear conception of objectives to be achieved. Evaluation was continuous, giving guidance to operation at all times. It was cooperative, making use of contributions from all those involved in the activity--students, teachers, and scientists. It was comprehensive covering all parts of the program of activities in science.

These features set forth in the literature referred to immediately above were the essentials of the evaluation procedures followed in this investigation.

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[26] R. S. MacArthur, "Evaluation and Research in Education," Canadian Education, IX, 2, (March, 1954), pp. 9-16.

# CHAPTER III

## THE DESIGN

In order to test the hypothesis that a carefully planned program of extracurricular activities in science for the students of Strathcona Composite High School will have enough educational value to warrant its continuation, a plan based on the following steps was evolved.

A. Compile a list of all extracurricular activities of possible value.

B. Establish objectives of extracurricular activities in science for the school.

C. Use the objectives as criteria in the selection of the activities to be promoted in the school.

D. Promote the selected activities when opportunities arise.

E. At the end of the school year make a final evaluation of:

   (1) the objectives.

   (2) the several kinds of activities engaged in.

   (3) the program as whole.

At this point it is desirable to enlarge somewhat upon the above steps.

Compilation of list of extracurricular activities. A basic list of activities in science meeting the definition of extracurricular activities given in Chapter I, was compiled from the literature on the subject and adapted to local resources. These became the activities to receive attention. The resulting list will be found in Chapter V of this paper.

Establishment of the objectives of the extracurricular activities. Objectives had to be tentatively set up at the beginning of the school year. It was considered advisable to leave any changes found desirable in these until the final evaluation of them was made at the end of the school year. Hence, a considerable effort was made to set them forth with some authority at the start. Their selection was guided by the following authoritative, or at least influential sources.

1. Objectives of the Alberta High School Curriculum.
2. Objectives of secondary school science programs for schools like ours.
3. Objectives of extracurricular activities.
4. The special needs of the members of the Science Club.
5. Psychological principles.

Chapter IV of this paper will give an account of the development of the fourteen objectives set for the program of extracurricular activities in science.

Selection of activities to be promoted. An analysis was made of each proposed activity in terms of the objectives set up. A chart was used to systematize the procedure. The activities showing most promise were to receive prior consideration in promoting the program for the school year 1959-60. The system of analysis will be found described in Chapter V of this paper.

Promotion of the selected activities. This was accomplished by first making known to the members of the Science Club all the possibilities that existed. Members or groups of members could initiate activity in any of the areas listed but the sponsor gave most encouragement and assistance in those which previous assessment had shown to be most promising. An

account of all of those activities carried on during the school year 1959-60 will be found in Chapter VI.

Final evaluation. The year end evaluation had three phases.

Evaluation of the objectives was accomplished by recording and analysing ratings made by science club members and science teachers of the relative importance of each of the fourteen objectives set up at the beginning of the year.

The net value of each of the nine kinds of activity engaged in during the year was determined by taking into account the measure of each of three elements. These can be simply identified as student participation, educational value, and ease of administration.

Extent of student participation was measured by keeping records of activity during the year 1959-60. Also participation in the future was estimated by means of partially structured interviews.

The educational value of each of the nine kinds of activity was appraised in three different ways. All three appraisals were made after the program for the year was complete. In one estimate, the sponsor simply arranged the nine items in rank order by inspection. In a second estimate the sponsor rated each activity on its achievement of each of the fourteen objectives of the program, and rank order was determined by taking the sum total of achievement for each activity. The third estimate was based on ratings given by student participants.

Ease of administration of each of the nine kinds of activity was appraised and considered in making some decisions.

In the case of two of the major activities participation was on a city wide basis and limited to one group of four and one group of six

students from Strathcona Composite High School. In both cases evaluation was aided by questionnaires to all participants and by the recorded impressions of the instructors.

The program as a whole was evaluated by taking into account the values of its component parts, and also by means of data from partly structured interviews with students.

Suggestions for improvement of certain parts of the program were elicited from students, science club sponsors, and from scientists who played a part in the program. These were recorded and in some cases analysed for common elements.

Some provision was made for follow up studies that should be attempted in the future in order to gauge some things not measurable over a short period of time.

This design outlines an effort to evaluate in a manner that is more objective than usual something that must be evaluated in some way. It is an attempt to do better by a concentrated effort something that is ordinarily a casual development.

Much of the investigation was aimed at securing evidence to test the hypothesis, but the author felt from the outset that anything approaching conclusive proof or disproof was too much to hope for.

Not all the data collected, however, was for the specific purpose of gaining evidence for or against the hypothesis. Much of it was intended to reveal weaknesses of the extracurricular program or some of its parts and to give guidance in future planning.

# CHAPTER IV

## OBJECTIVES OF THE SCIENCE CLUB

Every extracurricular activity needs to have clearly stated objectives. The Encyclopedia of Educational Research, 1960 makes the following observations.[1]

> Promising programs have often floundered because the objectives were not clear or were not shared by all.
>
> Too often even today, the school faculty seldom engages in any discussions of the goals to be served by student activities.

In the present study there was in addition to the usual desirability, a very special need for clearly defined objectives. The objectives were criteria for determining the worth of the extracurricular activities. It was necessary to set up objectives that would not only serve the usual guidance function, but also establish a suitable basis for evaluation.

The plan used in the development of the required objectives grew from a study of ideas expressed by Tyler.[2] From his exposition the factors that should be considered in establishing the objectives of extracurricular activities in science were adapted. The following six items were finally selected as guides.

1. Objectives of the Alberta High School Curriculum.
2. Objectives of secondary school science programs.

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[1]Roland C. Faunce, (ed. Chester W. Harris) Encyclopedia of Educational Research (New York: The Macmillan Company, 1960) p. 509.

[2]Ralph W. Tyler, Basic Principles of Curriculum and Instruction (Chicago: The University of Chicago Press, 1960).

3. Objectives of extracurricular activities.

4. The needs of members of the Science Club.

5. Local resources.

6. Psychological principles.

The prevailing philosophy is an important factor in the determination of objectives, but it was felt that since its effects were inherent in several of the other criteria it deserved no further consideration.

Since it was decided to look to the above six sources for direction in setting up objectives of the program of extracurricular activities in science, it was necessary to decide which one should form the framework on which to begin building. Objectives of secondary school science programs were thought to constitute the best fundamental material. This choice is now supported by the following quotation published subsequently to the time of the decision.[3]

> The root of the difficulty of definition (of extracurricular activities) lies in the fact that the purposes of the curriculum and the student activities program are the same.

A comprehensive list of objectives of secondary school science programs was compiled using Richardson[4] and the 46th Yearbook of the N.S.S.E.[5] as the main sources. From these references also came much of the detailed description and definition necessary to create a working

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[3] Roland C. Faunce, (ed. Chester W. Harris) Encyclopedia of Educational Research, p. 507.

[4] John S. Richardson, Science Teaching in Secondary Schools (Englewood Cliffs, N.J.: Prentice Hall Inc., 1957) p. 8.

[5] Committee on Science Education in American Schools, Science Education in American Schools, Forty-sixth Yearbook of the National Society for the Study of Education (Chicago: University of Chicago Press), 1947, p. 28.

knowledge of the objectives listed. Though no summary of the content of the list was used at the time of its preparation it seems appropriate to quote the following passage which was found to outline this basic material very well.[6]

> A synthesis of the various statements of objectives of science instruction which have appeared from time to time yielded the following five categories of objectives: (a) development of understanding and insight into the forces and nature of the environment; (b) development of knowledge and understanding of the facts, principles, and concepts of science; (c) development of personal growth in the habits and methods of science; (d) development of the interests and appreciations of the benefits of science; and (e) development of democratic social attitudes toward the resources of science.

The complete list of objectives and not a summary was used as raw material to be refined by the five remaining influences.

The general objectives of secondary education as outlined in the Senior High School Handbook[7] were so broad that they had little effect in reducing the original list, or even in changing the emphasis. A paragraph immediately following the statement of objectives in the handbook made it clear that some attention should be given to their attainment through extracurricular activities.

Consideration of objectives of extracurricular activities as they are generally conceived caused a much sharper reduction of the content of the list. McKown provided the main reference material,[8] but much use

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[6] Faunce, op. cit., p. 1220.

[7] Alberta Department of Education, Senior High School Handbook (Edmonton, Alberta: Queen's Printer, 1958), pp. 5-6.

[8] Harry C. McKown, Extracurricular Activities (New York: The Macmillan Company, 1952), pp. 13-17.

was also made of a detailed but less authoritative document prepared by a committee of Edmonton high school teachers.[9] Those things which were believed to be most effectively learned through extracurricular activities were allowed to retain their position in the list, while others thought to be the main product of the curriculum were concentrated into fewer units but usually not entirely eliminated.

The sponsor's appraisal of the needs of the members of the science club modified the list somewhat. It was anticipated that the members would be mainly highly motivated superior students and that the make-up of the club would permit ways of learning not commonly used in class and demand what is often called enrichment material. These materials and methods are, of course, better suited to the attainment of some aims than they are of others. Accordingly, some objectives were expanded because the program anticipated was ideally suited to their attainment.

The educational potential found in local resources played a part in moulding the pattern of objectives of the science club. There was no point in entertaining objectives that could not be realized. There was much reason to capitalize on situations that gave advantages. Therefore objectives were modified in the light of what was available and what was outstanding in local resources. The abundance of activity in scientific research and the multiplicity of conservation problems were accepted as influential factors.

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[9]Edmonton High School Local's Committee on High School Problems, Recommendations on the Aims and Objectives of Extracurricular Activities for Edmonton Senior High Schools, 1958.

Certain psychological principles were observed both in the selection and in the statement of the science club objectives. There was an avoidance of objectives toward which it was thought no one in the group would be willing to work. Discretion was exercised in noting whether any of the objectives were likely to be highly objectionable to certain members of the group or to institutions properly concerned with the welfare of the students.

Statements of the objectives were made as concise as possible in order to facilitate the process of rating them which was to be carried out by students and teachers. The list was examined in order to find a very simple classification system into which all its items would fit. The headings finally adopted were (a) scholarship (b) interest (c) service to others.

It seemed desirable for purposes of evaluation that all stated objectives should be of approximately equal importance. It was observed that seven of the objectives listed were directed toward elements of scholarship other than interest, five aimed at developing interest, and two had to do with services to people outside the immediate participants in science activity. The author believed that the 7:5:2 ratio of emphasis on scholarship, interest, and service to others was a reasonable one and saw no reason to adjust it without further information.

The product of the process of establishing tentative objectives for the planned program of extracurricular activities is given below. It was entitled "Objectives of the Science Club" because it was believed that ultimately the whole program of extracurricular activities would be undertaken by the science club.

## OBJECTIVES OF THE SCIENCE CLUB

Improved scholarship in science

1. Increased knowledge of scientific facts and principles.
2. Increased knowledge of scientific vocations.
3. Increased familiarity with scientific method.
4. Increased laboratory skills.
5. Increased desire for scholastic achievement.
6. Increased resourcefulness.
7. Increased tendency to search for the truth with an open mind.

Increased interest in science

8. Increased interest in reading material in the field of science.
9. Increased interest in science as a vocational field.
10. Increased interest in recreational activities related to science.
11. Increased tendency to associate with others with science interest.
12. Broadening of interests to more areas of science.

Service to others

13. By provision of educational materials and activities.
14. By attention to matters relating to conservation of resources.

These objectives remained unchanged throughout the school year but were modified at the year end according to findings made. These changes and the reasons for them will be found in a later chapter of this thesis.

# CHAPTER V

## PRE-ACTIVITY PLANNING OF THE SCIENCE CLUB PROGRAM

This chapter outlines plans made by the science club's sponsor before September, 1959.

### I. POLICIES FOLLOWED

Every sponsor of an extracurricular activity has certain policies in mind. In this study it seemed wise to write down the main policies for immediate clarification of thinking and for future reference. In the study of the literature on the operation of science clubs identified in Chapter II much about the policies pursued by others became evident. The sponsor's own experience modified by points made by McKown was the main source of the following policies.[1]

1. The already existent policy of starting small with provision for growing large was to be continued. Ventures into unexplored areas on a massive scale were to be avoided.

2. A permanent record was to be kept of all activities.

3. The school and community were to be kept well informed as to what was going on in the club.

4. Operation was to be as democratic as was practicable with increasing democracy as the members gained experience.

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[1] Harry C. McKown, Extracurricular Activities (New York: The Macmillan Company, 1956), pp. 17-25.

5. Membership was to be restricted only at the Grade X level where only honor students could be members. There were three main reasons for this. First, it would make the group more nearly homogeneous in respect to academic background. Second, it would slant the club toward the academic side of activities rather than mere toying with the tools of science. Third, it would stimulate the idea that it was a privilege to participate in activity beyond the curriculum.

6. The science club program was to be one of enrichment and extension beyond work done in regular classes.

7. Individuals were to be treated as though they were for the most part self motivated, not requiring compulsion in order to get things done. The way to get out of the club or out of any part of the program was to be wide open always, so that no one would be found tied to a task except by his own feelings and reasons.

8. The desire for knowledge was assumed to be the driving force on each individual and the policy was to encourage and feed this favorable condition to develop true scholarship.

9. Students were not to be taken out of classes in order to carry on science club activity.

10. Club activities were to be planned so as to avoid interference with homework.

## II. ORGANIZATION OF THE SCIENCE CLUB

Mapping out detailed organization of the club was deliberately avoided at this time. It was felt that this should be largely left to the members as there would be some continuity with the previous year's operations. The science club was one of many clubs operating under the Student's Union. It had no written constitution and had elected three officials, president, vice-president and secretary-treasurer the previous school year. It seemed that establishing a constitution should be part of the club's work during 1959-60.

## III. ASSISTANCE FOR THE SCIENCE CLUB

It was the sponsor's opinion that a special appeal for assistance made to business and industrial organizations would substantially increase the resources of the science club. A copy of the general part of the appeal which was sent to nine business and industrial organizations will be found in the appendix to this thesis. The results of this appeal will be described in Chapter VIII.

## IV. PLANNING ACTIVITIES

There were two phases to this task of preparing a suitable list of activities. Both parts were largely accomplished before the year of testing began in September 1959.

One phase was that of listing every kind of activity related to science mentioned in the literature on science clubs and science enrichment programs. The first items were taken from Richardson and

Cahoon[1] and additions made from many other sources as each new possibility was encountered. These sources have been already identified in Chapter II.

The second phase was that of thinking out and finding out the possibilities that existed for the following school year at Strathcona High School. The following twenty-seven kinds of activity were given consideration and retained in the list of promising items. These activities will be described as they were anticipated because this will reveal the basis on which the first appraisals of value were made. Also, this thinking represents an important step in the development of the science club program.

1. Collections of scientific interest. This old standby, it was thought, might be given new life as a group project in which interested club members established a biological or geological collection. Of course, individual collections would be promoted as well.

2. Photography of scientific interest. The multitude of ways in which photography serves science give rise to a vast number of possibilities. Discussion and reading would be necessary in order to make these known to the students already interested in the general field of photography. Photomicrography, time lapse photography, and many other techniques could be attempted.

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[1] J. S. Richardson and G. P. Cahoon, Methods and Materials for Teaching General and Physical Science (New York: McGraw-Hill Book Company, 1951).

3. Construction and testing of science club equipment. The previous year's experience had proven the feasibility of this activity. Certain demonstration pieces, tools, and auxiliary equipment would make interesting construction projects and yield useful products.

4. Research. Experiment and investigation pertinent to local conditions were thought to provide the most promising fields of research. However, if the term "research" is used with the great breadth of meaning it is sometimes given today, many more areas of scientific research are within the reach of a high school science club.

5. Trips to industrial plants and laboratories. Investigation showed that there were a number of local industries that would be prepared to show groups of students their processes. In most cases very small groups were preferred.

6. Trips to libraries. The possibility of trips to the Rutherford Library of the University of Alberta and the Edmonton Public Library were looked into. Since high school students could not gain the privilege of borrowing books from the Rutherford library, it was thereby less attractive than some of its features might tend to make it. The Edmonton Public library offered to experiment in giving assistance to a group of students sincerely interested in learning how to make the best use of its reading shelves, its reference section, and its periodicals.

7. Participation in research at the Research Council of Alberta. During the school year 1958-59 two teachers cooperated with a scientist

of the Research Council of Alberta who introduced a small number of students to certain aspects of a research project. The possibility of an expanded program of a similar nature for the year 1959-60 was explored. Plans were made to include about four outstanding students from each high school in the Edmonton Public School District in the group privileged to observe and participate in research under the instruction of several scientists of the Research Council.

8. Trips for nature study. This activity may at first seem to be always accessible and profitable. However, the sponsor felt that two particular requirements should be met before any trip was made. First, a group showing real interest in a field trip for a specific educational purpose should be formed. Second, able and enthusiastic leadership should be found.

9. Trips to the University of Alberta. Two kinds of trips seemed feasible. More extensive use could be made of the usual opportunities offered by the University. This use could easily be promoted in the science club. A second possibility considered was that of making arrangements for special visits by small groups with interests meriting special treatment.

10. Observing other members at work on projects. It was believed that something could be gained by promoting conditions whereby those people hesitant about becoming active themselves could informally watch those working on projects.

11. Viewing films. The success of a film program, it was reasoned,

would depend on securing films interesting enough to attract an audience during the noon hour, yet with enough educational value to make them worthwhile. Films were sought that were in line with the policy of enrichment or extension beyond the regular classroom subject matter. In an effort to determine what was available, fifteen sources of films were contacted and their catalogues or film lists obtained.

12. Reading resulting from science club activity. This feature seemed so important that it merited treatment as a separate activity even though it was linked with many others. As a separate item it was thought that it could be evaluated and modified more readily.

13. Participation in or listening to debates and discussions on chosen topics. Since free discussion might not touch on some topics that should be opened up for science club members, it was thought wise to make provision for a committee of students to inject vital ideas relating to club operation and to science in general.

14. Hearing reports on adult science organizations. To pave the way to eventual membership in some of Edmonton's several adult science organizations, it seemed desirable to acquaint science club members with their activities. It was expected that this could be accomplished by using connections that already existed between club members and the societies and supplementing them with newspaper reports.

15. Hearing special reports on the activities of club members. Some general interest was anticipated in outstanding projects and field trips enthusiastically reported to the whole club membership.

16. Hearing visiting speakers. It seemed that suitable visiting speakers could be found to speak to science club members at noon hour or after school. Early communication with several organizations indicated their willingness to supply speakers, but there were few of these whose subject matter and suggested treatment seemed appropriate to this use.

17. Psychological testing. Consideration was given to the use of aptitude tests for vocational guidance and for other values arising from discussion of them. It seemed that a place could be made for material illustrative of other fields of psychological testing also. Desire was expected to be keen to know how certain measurements were made and interpreted.

18. Mathematical games. Since liking for mathematical games is characteristic of people adapted to scientific work, it was planned to provide magazine and book sources of such games. Some thought was given to activity in which interested and capable individuals would make presentations involving teaching of or encouragement of participation in mathematical games.

19. Solving puzzles and problems. This was planned to be handled in the same way as the activity immediately above.

20. Business and organization meetings. Though these activities are instrumental in making all others function, they were expected to be worth while educational experiences in themselves. Meetings of the whole membership of the club held once a week were planned to make up a large

part of the total time spent by the members. Commensurate value was expected.

21. Preparing and giving demonstrations. In line with the policy of seeking enrichment rather than mere reinforcement of curriculum materials it was preferred that demonstrations put on by members of the science club have a degree of originality beyond that of the usual classroom demonstration. Sources of material for such demonstrations are listed in the appendix of this thesis.

22. Work on displays and exhibitions. A science fair held within the school was contemplated. The previous year's experience in this area had been encouraging. It seemed assured that there would be enough new projects to provide a core for a fair also showing some regular class work and a few intriguing show pieces. Some consideration was given to the possibility of establishing a museum of local industry in which scientific processes of the various industries of this community were described by printed matter, pictures, charts, and samples.

23. Selecting and showing films. A student committee, it was thought, would find experience of some value in doing these jobs to serve others.

24. Improvement of school laboratory equipment. Students had volunteered at times in the past to repair old equipment or devise new. It seemed that a deliberate effort to place some of the equipment problems before interested students would yield good results.

25. Acting as laboratory assistant. It was planned to appoint a small group of students to take turns doing certain regular duties in maintaining the physics laboratory equipment. It was expected that they would in return be granted the privilege of practicing certain techniques, such as glass blowing, in the laboratory.

26. Providing leadership for groups of nonmembers. The sponsor visualized situations in which other groups would apply to the science club for assistance. It seemed probable that among the club members would be found those who could give some help in the areas of photography, nature study, stage lighting, and the like. Assistance might even mean establishment of new groups outside the science club.

27. Maintaining the bulletin board and reading shelf. The necessity of a collection of reading material kept close at hand and containing some items not found in the school library was forseen. It seemed that several club members working together could best take care of this since it required extensive observation to obtain current materials.

Each of the above twenty-seven kinds of activity was rated according to the extent to which the sponsor estimated it would contribute to each of the fourteen objectives that had previously been established. Table I shows these ratings.

TABLE I

SPONSOR'S PREDICTION OF CONTRIBUTIONS TO THE ESTABLISHED OBJECTIVES LIKELY TO BE MADE BY PROPOSED ACTIVITIES

| ACTIVITIES | OBJECTIVES | | | | | | | | | | | | | | Total contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Facts and principles | Vocational information | Scientific method | Laboratory skills | Scholastic desire | Resourcefulness | Open mindedness | Reading interest | Vocational interest | Recreational interest | Science fellowship | Broadening influence | Service to nonmembers | Conservation consciousness | |
| 1. Collections | 3 | 1 | 3 | 4 | 2 | 4 | 1 | 2 | 3 | 4 | 2 | 0 | 1 | 1 | 31 |
| 2. Photography | 3 | 1 | 2 | 4 | 2 | 4 | 1 | 2 | 3 | 4 | 2 | 2 | 1 | 0 | 31 |
| 3. Construction | 3 | 0 | 3 | 4 | 2 | 4 | 1 | 2 | 2 | 2 | 2 | 1 | 4 | 0 | 30 |
| 4. Research | 4 | 1 | 4 | 4 | 4 | 4 | 1 | 3 | 4 | 0 | 2 | 3 | 0 | 1 | 35 |
| 5. Plant visits | 1 | 4 | 1 | 1 | 2 | 0 | 0 | 1 | 3 | 0 | 2 | 1 | 0 | 0 | 16 |
| 6. Library trips | 4 | 1 | 3 | 1 | 2 | 3 | 2 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 23 |
| 7. Research council | 2 | 4 | 4 | 2 | 3 | 1 | 1 | 2 | 3 | 0 | 2 | 2 | 0 | 1 | 27 |
| 8. Nature study | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 2 | 2 | 4 | 2 | 1 | 0 | 4 | 26 |
| 9. University visits | 1 | 2 | 1 | 1 | 2 | 0 | 0 | 1 | 3 | 1 | 1 | 3 | 0 | 0 | 16 |
| 10. Observing others | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 10 |
| 11. Viewing films | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 0 | 2 | 22 |
| 12. Reading | 4 | 2 | 3 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 0 | 4 | 0 | 0 | 27 |
| 13. Discussions | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 0 | 3 | 4 | 0 | 2 | 18 |
| 14. Adult organizations | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 3 | 2 | 1 | 2 | 0 | 4 | 19 |
| 15. Activities reports | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 1 | 10 |
| 16. Visiting speakers | 2 | 2 | 2 | 0 | 2 | 0 | 2 | 2 | 3 | 1 | 0 | 2 | 0 | 4 | 22 |
| 17. Psychological tests | 0 | 1 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 4 | 0 | 11 |
| 18. Mathematical games | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 2 | 0 | 2 | 0 | 11 |
| 19. Puzzles | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 2 | 0 | 2 | 0 | 12 |
| 20. Business meetings | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 4 | 3 | 4 | 0 | 16 |
| 21. Demonstrations | 3 | 0 | 1 | 4 | 1 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 4 | 0 | 20 |
| 22. Exhibitions | 1 | 0 | 1 | 1 | 1 | 3 | 0 | 1 | 2 | 1 | 3 | 2 | 4 | 2 | 22 |
| 23. Showing films | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 0 | 09 |
| 24. Equipment repair | 2 | 0 | 1 | 4 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 1 | 4 | 0 | 19 |
| 25. Laboratory assistant | 1 | 1 | 1 | 4 | 2 | 1 | 0 | 1 | 2 | 0 | 2 | 2 | 4 | 0 | 21 |
| 26. Leadership | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 1 | 1 | 1 | 3 | 1 | 4 | 2 | 18 |
| 27. Library duties | 1 | 1 | 1 | 0 | 1 | 2 | 0 | 3 | 2 | 1 | 2 | 3 | 4 | 4 | 25 |

0 represents no contribution
1 represents very little contribution.
2 represents moderate contribution.
3 represents extensive contribution.
4 represents very great contribution.

A five category rating scale with categories: no contribution, contributes very little, contributes moderately, contributes extensively, and contributes very greatly, represented by the numbers 0, 1, 2, 3, and 4 respectively was used. Since the objectives had been adjusted so as to be of roughly equal importance, the total of assigned values for each of the activities became a rough basis for their comparison.

The difficulty of administration was also estimated by the sponsor for each of the twenty-seven activities. This estimate was based on financial cost, supervision required, physical danger, interference with other school work, and value of physical product. An attempt to systematize the estimate failed because no basis was found for determining the relative importance of each of the six factors on which it was based.

Table II lists the proposed activities in rank order according to estimates of total value of each from Table I and gives the estimate of difficulty of administration of each.

Table II was the guide used in selecting activities promoted during the school year 1959-60.

TABLE II

ACTIVITIES LISTED IN ORDER OF ESTIMATED EDUCATIONAL VALUE ACCOMPANIED BY ESTIMATES OF DIFFICULTY OF ADMINISTRATION

| | ACTIVITY | DIFFICULTY OF ADMINISTRATION |
|---|---|---|
| 1. | Research | difficult |
| 2. | Collections | very easy |
| 3. | Photography | very easy |
| 4. | Construction | easy |
| 5. | Reading | * easy |
| 6. | Research council | very difficult |
| 7. | Nature study | difficult |
| 8. | Library duties | * easy |
| 9. | Library trips | moderate |
| 10. | Viewing films | easy |
| 11. | Visiting speakers | moderate |
| 12. | Exhibitions | difficult |
| 13. | Laboratory assistant | easy |
| 14. | Demonstrations | moderate |
| 15. | Equipment repair | easy |
| 16. | Adult organizations | easy |
| 17. | Discussions | very easy |
| 18. | Leadership | moderate |
| 19. | University visits | moderate |
| 20. | Plant visits | difficult |
| 21. | Business meetings | * very easy |
| 22. | Puzzles | easy |
| 23. | Psychological tests | difficult |
| 24. | Mathematical games | easy |
| 25. | Observing others | very easy |
| 26. | Activities reports | very easy |
| 27. | Showing films | * easy |

* Activities essential to the performance of others are marked thus.

Each activity is described more fully earlier in this chapter.

Ranking of the activities is according to the estimated educational values from Table I.

# CHAPTER VI

## DESCRIPTION OF SCIENCE CLUB ACTIVITIES CARRIED ON DURING THE SCHOOL YEAR 1959-60

This chapter briefly describes all extracurricular activities in science carried on by the students of the Strathcona Composite High School and under the supervision of the science club sponsor, during the school year 1959-60. This information is required as a basis for understanding the evaluation and development processes that are the main part of this thesis.

There was no early effort to write a constitution for the science club, since the background of experience of the membership in September, 1959 was not considered sufficient for the undertaking. Four officials were elected to the executive and four committees were set up to take care of projects promotion, bulletin board and reading shelf, materials and equipment, and film showing.

It will be observed that the list of activities carried out does not correspond to that of activities proposed in Chapter V. The reason for this is that the list of twenty-seven items was found to be too long and detailed to serve as an evaluation device where the judgments of students are to be clearly expressed. The first three months of activity made this defect apparent and a simpler system of classification was sought. It was found that all activities being pursued could be

definitely classified under the following simple headings.

1. Projects
2. Field trips
3. Films
4. Science fair
5. Reading shelf
6. Special physics lectures
7. Research Council program
8. Laboratory assistants
9. Business meetings

The description of these activities which follows immediately will make clear the content under each of the headings.

Projects. Many students showed interest in working on projects right from the time the possibilities were first discussed. However, good projects did not develop easily.

The pitfalls surrounding this activity were many and the ranks of project workers were rapidly thinned. Some workers lacked clearly defined objectives and lapsed into somewhat aimless tinkering before they finally dropped their projects. Some attempted projects that were beyond the means of themselves and the club and were unable to derive much satisfaction from their minor accomplishments. None of the groups of more than three people were successful in working together on a single project. Many students formed plans that showed promise but were not stimulated to the point where they gave the time and effort necessary to carry them out.

Some projects were successfully completed and from them stemmed the general enthusiasm for more activity in this line. One student followed a plan from a teacher's magazine in building a device for the measurement of acceleration due to gravity. Two others built a Van de

Graaf generator. A group of three built a simple device for separating a stream of compressed air into two streams with a temperature difference of 30 centigrade degrees. Specifications obtained through the Physics Department of the University of Alberta were followed for the last mentioned project. All three of these projects invite further investigation and development. At least two of them are continuing.

Other projects which drew some interest had to do with measurement of rocket thrust, effects of gibberellic acid on plant growth, study of diatoms, cloud chamber observations, stroboscopic effects, and use of thermocouples to measure temperature differences. Though most of these were not carried through to the point of development hoped for by their planners, it seems that much useful experience was gained.

Field trips. Three field trips were undertaken. Each had a special purpose and involved but a small number of pupils.

Twelve students accompanied the sponsor to the Edmonton Public Library for the purpose of learning to use its reference section and periodicals. A capable member of the library staff instructed the group to this end during a time when the library was closed to the public generally.

Four students and the science club sponsor visited the mineralogy laboratory at the University of Alberta to see how minerals are classified and arranged in collections.

Six students and the sponsor visited the low temperature laboratory of the Physics Department of the University of Alberta to obtain some direction in developing a project.

For all three trips many more students indicated an interest and in some cases an intention of going but when the time came for each trip the numbers had dwindled. Most drop-outs gave as reasons other school activities and homework that had not previously been taken into account.

Films. There were eleven showings of science films during the year. The average time of showings was about thirty minutes. The average attendance was about thirty-five viewers. Some films were obtained from sources other than the usual film supply services.

Science fair. A science fair was held within the school in conjunction with a tea sponsored by the Home and School Association. Students exhibited the projects already described, showed some regular class work, and set up some thought provoking display pieces. A descriptive sheet prepared for the science fair will be found in the appendix.

Reading shelf. A reading shelf was built up early in the school year. The materials were displayed so as to attract the attention of new readers. The chief components were back copies of magazines loaned to the shelf by the sponsor and science club members, free materials from industrial concerns, and clippings from current publications, as well as some books calculated to stimulate interest and to serve the activities being carried on.

Special physics lectures. After the school year was well begun the Department of Extension of the University of Alberta organized a series of ten two-hour physics lectures designed to stimulate the thinking of outstanding high school students. The writer was present at the

organization meeting to encourage the experiment and learn how to make the best use of its opportunities. Six students from Strathcona Composite High School attended the series of lectures along with the writer. Most of the lectures were given by two physics professors of the University of Alberta, while three others contributed lectures from their special areas of investigation.

Research Council program. Four outstanding students from the Strathcona Composite High School along with the writer formed a group under the instruction of a prominent scientist at the Research Council of Alberta. The group participated in a research project related to some of the scientists' major investigations in physical chemistry. Attendance was almost perfect at the fourteen Saturday morning sessions of about two and a half hours each.

Laboratory assistants. Five pupils were selected from sixteen that volunteered to be laboratory assistants. A schedule was drawn up according to which one of the five assistants was to be on duty each day of the week. The main work was to serve the other science club members by getting from the storeroom the things needed for certain activities and returning them in good order after use. The practice continued throughout the year.

Business meetings. Business meetings intended for the whole membership of the club were held every Monday that was a school day from the first of September to the end of May with three exceptions at examination times. Twelve additional meetings were held by small groups

with special interests. Meetings averaged about forty minutes in length.

It should be noted that all activities engaged in were carried on outside of regular school time and that at no time was a student taken from a class in order to participate in any of these activities. The policy of avoiding any pressures that might cause a student to neglect homework in favor of science club activities was also adhered to.

# CHAPTER VII

## EVALUATION PROCEDURES

The devices and procedures used in evaluating the many features of the program of extracurricular activities in science are grouped according to whether they were to evaluate objectives, the nine kinds of activities comparatively, the Research Council educational program, the special physics lectures, or the program of activities as a whole. In several cases part of an instrument was used for one purpose above while another part of it served another of the purposes.

### I. PROCEDURES USED TO EVALUATE OBJECTIVES OF THE SCIENCE CLUB

In connection with year end interviews of thirty-six pupils who participated in extracurricular activities in science, each pupil was asked to rate each of the fourteen objectives established by the sponsor. The five categories used were; (a) not worth considering, (b) unimportant, (c) deserves some consideration, (d) important, (e) very important. The five categories were assigned the values 1, 2, 3, 4, and 5 and the median rating and the quartile deviation determined for the ratings of each objective. Nonparametric statistics were used because measurement of the data was at the ordinal level.

The same procedure was followed with data obtained in a similar manner from a group made up of two school administrators, two guidance counsellors, two science department coordinators, and four science teachers all of whom were well acquainted with science activities in composite high schools. This group will be referred to from here on as

the teachers group.

The median test was used to determine the significance of differences between pupil's ratings and teacher's ratings of the objectives.[1] The sign test was used to determine which objectives were rated significantly higher than the lowest rated objective and which ones were rated significantly lower than the highest rated objective.[2]

In order to make comparisons with the writer's own estimate of the relative importance of each objective, the median ratings by the pupils and teachers were used to obtain rank orders of their ratings of the fourteen objectives.

Spearman's $\rho$ was calculated for each possible combination of the three sets of rankings and tested for significance with a one tailed test in each case.[3]

## II. PROCEDURES USED TO DETERMINE RELATIVE EDUCATIONAL VALUES OF THE NINE KINDS OF ACTIVITIES ENGAGED IN

After completion of science club activity for the year 1959-60, the sponsor arranged the nine classes of activities experienced in rank order according to directly estimated educational value.

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[1]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company, Inc., 1956), pp.111-116.

[2]Ibid., pp. 68-74.

[3]George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1959), pp. 179-183.

Next, a more analytical approach was used in which the sponsor estimated the contribution made by each activity to each of the fourteen objectives. The assumption of approximate equality of importance of the objectives was made and a total educational value for each of the nine activities was determined by adding together the estimated contributions made to each of the fourteen objectives. Table III shows this process. The totals obtained by the process were used to arrange the nine activities in rank order according to educational value.

TABLE III

ANALYSIS OF EDUCATIONAL VALUE OF THE NINE KINDS OF ACTIVITIES CARRIED ON

| | Facts and principles | Vocational information | Scientific method | Laboratory skills | Scholastic desire | Resourcefulness | Open mindedness | Reading interest | Vocational interest | Recreational interest | Science fellowship | Broadening influence | Service to nonmembers | Conservation consciousness | Total contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Projects | 3 | 1 | 3 | 3 | 3 | 4 | 2 | 3 | 2 | 0 | 3 | 1 | 2 | 0 | 30 |
| 2. Field trips | 2 | 1 | 2 | 1 | 3 | 0 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 15 |
| 3. Films | 3 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 0 | 1 | 4 | 1 | 19 |
| 4. Science fair | 1 | 0 | 0 | 2 | 3 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 2 | 0 | 16 |
| 5. Reading shelf | 2 | 2 | 1 | 1 | 2 | 0 | 2 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 24 |
| 6. Physics lectures | 4 | 2 | 3 | 1 | 3 | 0 | 3 | 3 | 2 | 0 | 3 | 0 | 0 | 1 | 25 |
| 7. R. C. A. program | 3 | 4 | 4 | 3 | 2 | 2 | 3 | 2 | 1 | 0 | 3 | 1 | 0 | 0 | 28 |
| 8. Laboratory assistant | 1 | 1 | 2 | 4 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 15 |
| 9. Business meetings | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 3 | 1 | 4 | 1 | 14 |

0 represents no contribution.
1 represents very little contribution.
2 represents moderate contribution.
3 represents extensive contribution.
4 represents very great contribution.

A third rank order arrangement of the nine activities was derived from information obtained and recorded during the interviews with thirty pupils each of whom participated in more than one of the activities. Each pupil was asked to arrange in rank order according to educational value those activities in which he participated. This resulted in a body of data that presented a new problem in analysis. Each activity was matched with each of the other eight activities to determine which member of each pair should be higher in rank order. The member of the pair placed higher by a majority of pupils was given the higher position of the two. Table IV shows the result of this process.

The data on the estimated educational values of the activities was ordinal at best and precluded the use of parametric statistics. Spearman's Coefficient of Rank Correlation was computed for each possible combination of the three rankings and tested for significance in each case. Observations were made as to which activities were consistently placed high and which were consistently placed low by the three different ranking procedures.

TABLE IV

THE METHOD OF DETERMINING THE RANK ORDER OF NINE KINDS OF ACTIVITIES ACCORDING TO VALUE AS ESTIMATED BY PUPILS PARTICIPATING

A represents projects.

B represents field trips.

C represents films.

D represents science fair.

E represents reading shelf.

F represents special physics lectures.

G represents Research Council program.

H represents laboratory assistant.

I represents business meetings.

The majority of pupil participants placed

A above B, C, D, E, H, and I
B above I
C above F, H, and I
D above C, E, and I
E above B and I
F above C, D, E, and I
G above C, D, and I
H above E, and I
I above no other

From these data there was no conflict encountered in assigning rank orders as follows:

| Objective -A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|
| Rank order-2 | 8 | 5 | 4 | 7 | 2 | 2 | 6 | 9 |

The positions of objectives A, F, and G were indistinguishable in respect to each other, therefore they were all assigned the median value of the first three ranks.

## III. PROCEDURES USED IN EVALUATING THE ALBERTA RESEARCH COUNCIL EDUCATIONAL PROGRAM

Questionnaires were sent to the twenty-four participating students from high schools of the Edmonton Public School District who participated in the educational projects at the Research Council of Alberta.[4] Twenty of these were returned satisfactorily completed. Three notes with partial data were received from three of the others whose questionnaires had gone astray. Some of the data from the questionnaires lent itself to simple summarization while some of the comments had to be examined for frequency of occurrence of certain important ideas.

Each of the seven instructing scientists wrote an account of his experience with the high school students in which he pointed out the strengths and weaknesses of the program as he saw them.

Six of the participating teachers were interviewed and gave answers to certain specific questions about the project as well as opinions regarding modifications desirable for the future. A summary sheet was prepared from this information.

## IV. PROCEDURES USED IN EVALUATING THE SPECIAL LECTURES IN PHYSICS

Questionnaires were given or sent to the thirty-three students from schools of the Edmonton Public School District who attended the special evening lectures in physics. Thirty-one of these were satisfactorily

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[4] See the appendix for a sample of this questionnaire.

completed. Summarization of some of the data made its interpretation relatively simple but the comment sections had to be examined closely in order to sort out the prevailing ideas.

Written comment by one of the two main lecturers and an interview with the other supplied another point of view.

## V. PROCEDURES USED IN EVALUATING THE PROGRAM OF EXTRA-CURRICULAR ACTIVITIES IN SCIENCE AS A WHOLE

Certain interview questions asked the thirty-six pupils who participated in extracurricular activities in science were to determine opinion regarding the worth of the program of activities as a whole. A question regarding the amount of time each pupil intended on spending in each activity the following year was intended to be an indicator of interest. A question about parental attitude toward the pupil's participation was to indicate the degree of acceptance of the program by parents.

If objectives of the science club were good and if they were achieved to some extent then there is evidence of good results from the program of extracurricular activities in science. Previous analysis had investigated the validity of the objectives. At this point the interview data were examined to see whether or not students had participated in those activities expected to yield greatest value. Their intended participation in the future was investigated in the same way.

A study of the composition of the membership of the science club was made with particular attention to level of intelligence and school marks in science and mathematics over the past two school years.

## VI. EVALUATION INSTRUMENTS USED

All instruments used except item 4, the scientists' 12 page report, are represented in the appendix to this thesis.

1. The Weekly Record of Participation in Science Club Activities. This form was issued to 29 members of the science club on September 28, 1959 with oral instructions regarding its use. The forms were then posted on the bulletin board where students were to mark their records weekly. A few students were very interested in the procedure, but it was pronounced a failure in regard to validity in December when eight students were interviewed regarding the accuracy of their marked records and the data proved to be in error in many cases. No data from this record was used for any purpose other than a casual review of activities engaged in by pupils.

2. The Questionnaire to Students Participating in Educational Projects at the Research Council of Alberta. These forms were mailed to the teachers who had supervised the students during the activity at the Research Council. The teachers gave them to the students after all programs were completed. The students filled in and returned the forms with no instructions other than those printed on the forms.

3. The interviews with the six teachers who participated in the Research Council program. These were very brief, consisting of the prepared questions and free discussion that followed them. Four of the six were conducted by telephone.

4. The data from instructing scientists of the Research Council of Alberta. This was obtained from a 12 page report compiled from contributions by all 7 scientists.

5. A Questionnaire to Evaluate the University of Alberta Evening Classes in Physics for Selected High School Students. This form was distributed at the conclusion of the last lecture of the year, completed immediately by the respondents and handed in. The writer was concerned about the effect the atmosphere might have on the responses. The final stimulating talk of the year had just been given and it seemed possible that the short term effects might have been unduly represented in some of the open remarks called for on the questionnaire.

6. Interviews of participants in extracurricular activities in science. These were conducted at the school during the noon hour by the sponsor who read all questions from a guide sheet and wrote or checked responses on a prepared form. Discussion was allowed to grow out of any question if the pupil promoted it.

7. The rating of objectives. This was done by having the respondent place check marks in one of 5 columns of a prepared form which was used in conjunction with a printed list of the objectives. The writer was always present but not observing directly during the response and was asked to interpret objective number 13 on at least 3 occasions.

## VII. VALIDITY AND RELIABILITY OF INSTRUMENTS

Objectivity demanded some consideration of the validity and reliability of the above mentioned evaluation instruments.

It would have been impractical to attempt to validate all of the above instruments empirically. Therefore, a strong effort was made to achieve content validity in the questionnaires and structured portions of interviews by asking questions that enabled establishment of validity deductively. Content validity was particularly important in that part of the data which was to be used for direct interpretation and diagnosis. In many cases lack of external criteria precluded determination of concurrent validity. A more extended period of development and study would have made possible the determination of the predictive validity of some parts of the questionnaires and interviews.

It will be noted that the Weekly Record of Participation (Item 1 in the list of instruments above) was found to be so lacking in concurrent validity when compared to a more trusted criterion that its results were rejected.

Checks on reliability were often sacrificed in the interest of keeping the burden of questions to participants and instructors to a minimum. There was no use of parallel forms or repetitions. The highly motivated scientifically oriented condition of the individuals questioned was expected to contribute to objectivity in answering questions.

The extra effort required for interviews was expended in order to obtain more valid and reliable data without causing the respondents to feel unduly burdened by the evaluation processes. The respondents, in all cases, seemed to take pleasure in presenting their own views and decisions to the interviewer. This attitude was thought to be highly important to future development.

# CHAPTER VIII

## SUMMARY OF FINDINGS

The research findings of this thesis are presented in this chapter in a pattern similar to that used in dealing with evaluation procedures in the previous chapter.

### I. FINDINGS RELATING TO OBJECTIVES OF THE SCIENCE CLUB

Table V summarizes the information obtained from the rating of 14 objectives by 36 pupils in one group and 10 teachers in another by the procedures described in Chapter VII. Application of the median test required the use of the original data for both teachers and pupils in order to obtain a combined median and a Chi-square test. The median test showed that teachers' ratings of any single objective were not significantly different at the .05 level from pupils' ratings of the same objective.

All quartile deviations for both teacher's and pupil's ratings were below the theoretical value of 1.25 that they would have a tendency toward if assignment of ratings had been purely at random. This indicates a good degree of agreement on ratings of individual objectives.

The sign test for significance of difference between ratings given by pupils showed that nine of the fourteen objectives were rated significantly below the highest rated objective, and that six of the 14 objectives were rated significantly above the lowest rated objective when the .01 level of significance was the criterion.

Teachers' ratings placed only 5 of the objectives significantly below the highest rated objective and one of them above the lowest rated

TABLE V

MEDIAN VALUES AND QUARTILE DEVIATIONS OF RATINGS ASSIGNED TO OBJECTIVES OF THE SCIENCE CLUB BY PUPILS AND TEACHERS

| | TEACHERS | | PUPILS | |
|---|---|---|---|---|
| OBJECTIVE | MEDIAN | Q | MEDIAN | Q |
| 1. Facts and principles | 4.67 | .48 | 4.44 | .60 |
| 2. Vocational information | 3.07 | .36 | 3.50 | .70 |
| 3. Scientific method | 4.67 | .54 | 3.83 | .64 |
| 4. Laboratory skills | 3.25 | .69 | 4.06 | .52 |
| 5. Scholastic desire | 4.00 | .71 | 3.79 | .66 |
| 6. Resourcefulness | 4.17 | .81 | 3.70 | .79 |
| 7. Open-mindedness | 4.67 | .66 | 4.22 | .65 |
| 8. Reading interest | 3.83 | .46 | 3.88 | .53 |
| 9. Vocational interest | 3.00 | .42 | 3.50 | .88 |
| 10. Recreational interest | 2.83 | .62 | 3.19 | .66 |
| 11. Science fellowship | 3.17 | .96 | 3.74 | .63 |
| 12. Broadening influence | 4.06 | .28 | 3.94 | .53 |
| 13. Service to nonmembers | 2.90 | .53 | 3.75 | .62 |
| 14. Conservation consciousness | 3.70 | .72 | 3.30 | .68 |

The median test showed that in no case was the difference between the teacher's median and the pupil's median significant at the .05 level.

objective when the level of significance was taken to be .01.

We then have confidence that certain objectives are believed to be more important than others and we can identify those rated highest and those rated lowest in importance by each of the two groups doing the rating. Since some values of N as used in the sign test were below and some were above 25, two different processes were used in determining significance and a single set of comparable data was not obtained. The best picture of high and low rated objectives can be got from the medians listed in Table V along with the added information that the sign tests showed only objective number 1 to be rated significantly higher than the lowest rated objective, and only objectives 2, 9, 10 and 13 to be rated significantly lower than objective number 1 by both groups doing the rating.

Three rank orders of the objectives according to their importance, determined in three different ways are shown in Table VI. Spearman's rank coefficient of correlation ($\rho$) for each combination of the rankings was found to be as follows:

| | |
|---|---|
| Sponsor's and teachers' ratings | .44 |
| Sponsor's and pupils' ratings | .38 |
| Teachers' and pupils' ratings | .68 |

The one-tailed test for significance of $\rho$ for an N of 14 shows that the critical points are .456 for the .05 level and .645 for the .01 level of significance. Thus, the first two values of $\rho$ were found to be not significant even at the .05 level while $\rho$ for teacher and pupil ratings was found to be significant at the .01 level.

When the three values of Spearman's $\rho$ are treated as if they were values of Pearson's r and converted to corresponding Fisher's z coefficients

TABLE VI

RANKINGS OF THE OBJECTIVES OF THE SCIENCE CLUB ACCORDING TO THEIR IMPORTANCE BY THE SCIENCE CLUB SPONSOR, BY THE TEACHERS, AND BY THE PUPILS

| | Objectives | Ranking by sponsor | Ranking by teachers | Ranking by pupils |
|---|---|---|---|---|
| 1. | Facts and principles | 4 | 2 | 1 |
| 2. | Vocational information | 5 | 11 | 11.5 |
| 3. | Scientific method | 1 | 2 | 6 |
| 4. | Laboratory skills | 10 | 9 | 3 |
| 5. | Scholastic desire | 9 | 6 | 7 |
| 6. | Resourcefulness | 11 | 4 | 10 |
| 7. | Open-mindedness | 2 | 2 | 2 |
| 8. | Reading interest | 3 | 7 | 5 |
| 9. | Vocational interest | 12 | 12 | 11.5 |
| 10. | Recreational interest | 13 | 14 | 14 |
| 11. | Science fellowship | 6 | 10 | 9 |
| 12. | Broadening influence | 14 | 5 | 4 |
| 13. | Service to nonmembers | 7 | 13 | 8 |
| 14. | Conservation consciousness | 8 | 8 | 13 |

The rank orders of the ratings by teachers and pupils were obtained from the data of Table V.

in order to apply a crude test of the significance of the differences between the values of $\rho$, none of the differences existing are found to be significant at the .05 level.

Thus, while we find the pupils' ratings of objectives significantly related to those of the teachers, and the sponsor's ratings significantly related to neither of the other two, there is still no direct evidence that any pair of the three ratings is more closely related to each other than any other pair of them. However, the evidence is not necessarily conflicting. It merely means that there is strong evidence of a relationship between pupils' and teachers' ratings, and that evidence of other relationships which may exist is not as strong.

Table VII presents summarized data that is intended to provide a basis for subjective judgments regarding the opinions of the teachers interviewed and those of the pupils in the science club relating to the objectives established by the science club sponsor.

## II. FINDINGS RELATING TO RELATIVE VALUES OF ACTIVITIES

Table VIII shows three rank orders of nine kinds of activities as they were determined in the three different ways described in Chapter VII.

The three values of $\rho$ obtained are discussed to some extent under Table VIII. Further investigation showed that if the three values are treated in the manner prescribed for Pearson's r then no one of them is significantly different from any of the others at the .05 level.

Thus we have strong evidence of a positive relationship between the sponsor's ranking of the activities according to educational value as determined by analysis and their ranking by the pupils' direct estimate.

TABLE VII

THE FREQUENCY OF PLACEMENT OF OBJECTIVES IN THE COMBINED TWO LOWEST CATEGORIES AND ALSO IN THE COMBINED TWO HIGHEST CATEGORIES BY TEACHERS AND PUPILS

| Objective number | Frequency of teacher's ratings | | Frequency of pupil's ratings | |
|---|---|---|---|---|
| | Unimportant or lower | Important or higher | Unimportant or lower | Important or higher |
| 1 | 0 | 10 | 0 | 33 |
| 2 | 1 | 2 | 3 | 18 |
| 3 | 0 | 9 | 1 | 23 |
| 4 | 2 | 4 | 0 | 28 |
| 5 | 1 | 7 | 1 | 22 |
| 6 | 1 | 7 | 1 | 20 |
| 7 | 0 | 8 | 2 | 28 |
| 8 | 0 | 7 | 0 | 23 |
| 9 | 2 | 2 | 6 | 18 |
| 10 | 3 | 1 | 7 | 13 |
| 11 | 3 | 4 | 4 | 23 |
| 12 | 0 | 10 | 1 | 26 |
| 13 | 3 | 2 | 2 | 22 |
| 14 | 2 | 6 | 6 | 15 |

The objectives rated are those listed in Table V and Table VI and more fully described in Chapter IV.

TABLE VIII

RANK ORDERS ACCORDING TO EDUCATIONAL VALUE ASSIGNED TO NINE KINDS OF ACTIVITIES BY SPONSOR'S DIRECT ESTIMATE, BY SPONSOR'S SYSTEMATIC ANALYSIS, AND BY PUPILS WHO PARTICIPATED IN THE ACTIVITIES

| Kind of activity | Ranking by sponsor's estimate | Ranking by sponsor's analysis | Ranking by participating pupils |
|---|---|---|---|
| 1. Projects | 3 | 1 | 2 |
| 2. Field trips | 4 | 7.5 | 8 |
| 3. Films | 7 | 5 | 5 |
| 4. Science fair | 8 | 6 | 4 |
| 5. Reading shelf | 6 | 4 | 7 |
| 6. Physics lecture | 2 | 3 | 2 |
| 7. R. C. A. program | 1 | 2 | 2 |
| 8. Lab. assistant | 5 | 7.5 | 6 |
| 9. Business meetings | 9 | 9 | 9 |

Spearman's $\rho$ for each combination of rankings above was found to be as follows:

| | |
|---|---|
| Sponsor's estimate and sponsor's analysis | .70 |
| Sponsor's estimate and pupil's estimate | .67 |
| Sponsor's analysis and pupils's estimate | .85 |

The first two values of $\rho$ show a significant relationship at the .05 level but not at the .01 level while the last value shows a significant relationship at the .01 level.

There is some evidence of relationships between all other pairs of rankings and no direct evidence that any pair of the three rankings is more closely related than any other pair of them.

Use of less rigorous methods reveals some features of Table VIII that seem to be worthy of attention. Three kinds of activities, namely projects, R. C. A. program, and physics lectures share the top three ranks, and business meetings take last place in the order for all three ways of rating them.

The sponsor's rating of the relative difficulty of administration of the particular nine kinds of activities carried on was based on the same criteria used for similar ratings discussed in Chapter V. The results are shown below.

| | | |
|---|---|---|
| 1. | Projects | difficult |
| 2. | Field trips | difficult |
| 3. | Films | easy |
| 4. | Science fair | difficult |
| 5. | Reading shelf | easy |
| 6. | Physics lectures | easy |
| 7. | R. C. A. program | very difficult |
| 8. | Lab. assistant | moderate |
| 9. | Business meetings | very easy |

It should be noted that at the time of this rating the sponsor had experienced all of the activities rated.

## III. FINDINGS RELATING TO THE RESEARCH COUNCIL OF ALBERTA EDUCATIONAL PROGRAM

The data on this activity obtained under less closely controlled conditions will receive less rigorous treatment.

The following information was obtained from the questionnaire answered by 20 participating students. The mean time of attendance was

approximately 24 hours under instruction. Attendance was 95% of possible attendance for those privileged to attend. One half of the absences were attributed to illness. In regard to the time spent on this activity; 1 student expressed the belief that the amount of time was too great, 6 that it was too little, and 13 that it was just right. Replies concerning the balance between experimental and theoretical work showed 6 students feeling that there was too much experimental work, 8 that there was too much theoretical work, and 6 others that the balance between the two was about right.

Question V from the questionnaire elicited opinions regarding the effect the experience at the Research Council had upon the student's actions and plans. Examination of the replies revealed that 4 of the students gave indication of being influenced toward a career in scientific research, 5 indicated being influenced away from it, and 11 others gave no clear indication.

A study of the suggestions as to how the program could be improved brought out the following points. Four students expressed favour of more breadth in the individual studies carried on. Four indicated that they felt that discussions were often at too high a level for the students, and two students preferred greater choice of subject matter according to students' interests.

The following two statements and list of ideas summarize six participating teachers' responses to some questions regarding organization and development of the educational projects carried on at the Research Council of Alberta.

All six teachers favored continuing the project another year but

modifying it considerably.

There was no general agreement regarding the suitability of the balance between theoretical and experimental work carried on during the year.

The following ideas were put forward by one or more of the teachers participating.

1. Introduce all the students attending to the activities of the Research Council, then allow them some choice regarding project followed.

2. Let the students see more of the Research Council's more direct services to the public.

3. Arouse student interest first. Delay discussions of difficult theory until after this is done.

4. Carry on work at the school related to the project being followed at the Research Council. Have some preparatory work done by the teacher and the students. Select projects where this is feasible.

(Note: The central idea in item 4 above was the only one submitted by more than one teacher.)

The reports written by seven instructing scientists assessing the educational program in which each engaged, contained several points useful in general evaluation and in revising the programs. Disappointment because of lack of enthusiasm on the part of the students was expressed by three of the scientists. Four instructing scientists suggested that student selection should be on some basis other than that used. All but one expressed sufficient optimism regarding the program to indicate that his participation in the program for another year was at least a possibility.

The findings from all three sources were discussed at a meeting attended by five of the supervising teachers and seven of the instructing scientists, and plans were made to attempt a much modified program during the school year 1960-61.

There is much concern over the educational value of this activity because of the high rate of expenditure of effort in order to achieve it.

## IV. FINDINGS RELATING TO THE SPECIAL PHYSICS LECTURES AT THE UNIVERSITY OF ALBERTA

The 31 questionnaires completed and returned indicated that all 31 respondents intended going to university and that 18 of them intended registering in physics or mathematics. Expression in regard to the amount of time spent on the activity was that none felt that the time spent was too great, 20 students felt it was just right and 11 felt that too little time was spent when the welfare of the student was considered.

Of the 31 respondents, 19 indicated that the lectures had stimulated them to do extra reading in physics, while 14 said they carried on experiments or organized discussions related to the lecture topics.

In regard to suggested modifications, the following points were outstanding. Of the 31 students, 12 expressed opinions that much of the material presented was beyond their understanding. Eight indicated that they would have liked a more thorough study achieved either by narrowing the field or by increasing the time spent. The students generally expressed much enthusiasm for the program and many indicated confidence in its value to them.

The lecturers reported that they were well pleased with the student response and felt that their time had been well spent.

## V. FINDINGS CONCERNING THE PROGRAM OF EXTRACURRICULAR ACTIVITIES AS A WHOLE

The interviews held with 32 pupils who participated extensively in extracurricular activities in science yielded much information in addition to that already given in discussion of objectives and particular activities.

Only 21 of the 32 pupils expected to return to the school for the 1960-61 school year. This group replied as follows when asked to indicate the amount of time they expected to spend in science club activity next year.

| | |
|---|---|
| No time at all ..... | 0 students |
| Less time than this year ..... | 2 students |
| Same time as this year ..... | 5 students |
| More time than this year ..... | 14 students |

The 32 pupils expressed the following opinions of their parents' attitudes regarding their participation in extracurricular activities in science.

| | |
|---|---|
| Parents strongly disapprove ..... | 0 students |
| Parents disapprove ..... | 0 students |
| Parents indifferent ..... | 2 students |
| Parents approve ..... | 19 students |
| Parents strongly approve ..... | 11 students |

The participation of the 21 students during 1959-60 and their indicated intended participation during 1960-61 in eight kinds of activities expected to continue during that school year were as

follows:

| | Participation 1959-60 | Intended Participation 1960-61 |
|---|---|---|
| 1. Projects ..... | 13 students | 20 students |
| 2. Field trips ..... | 7 students | 15 students |
| 3. Films ..... | 19 students | 18 students |
| 4. Science fair ..... | 13 students | 21 students |
| 5. Reading shelf ..... | 16 students | 20 students |
| 6. Physics lectures .. | 3 students | 9 students |
| 7. R. C. A. program .. | 0 students | 14 students |
| 8. Business meetings . | 4 students | 21 students |

When the 21 students were asked to indicate which activities they preferred for the next year by stating first, second, and third choices from among the eight activities likely to be available, they indicated as follows:

| | First choices | Second choices | Third choices |
|---|---|---|---|
| 1. Projects | 10 | 6 | 1 |
| 2. Field trips | 1 | 1 | 3 |
| 3. Films | 0 | 5 | 4 |
| 4. Science fair | 0 | 5 | 8 |
| 5. Reading shelf | 1 | 0 | 0 |
| 6. Physics lectures | 2 | 2 | 4 |
| 7. R. C. A. program | 7 | 2 | 0 |
| 8. Business meetings | 0 | 0 | 1 |

It should be noted that it is well known to the students that participation in the R. C. A. program and attendance at the physics lectures is restricted to a small number of students and that participants must have very high academic standing.

It should be noted that the three activities that were consistently ranked highest in educational value, namely projects, the R. C. A. program, and special physics lectures are the three with the highest frequencies of first choices for next year's participation.

## VI. SOME INDICATIONS OF SCHOLASTIC ABILITY AND ACHIEVEMENT OF PARTICIPATING PUPILS

This information was gathered in order to get a better picture of the club membership so that the program might be adjusted to its needs. Also it may indicate need for changes in policy regarding membership.

The level of intelligence and scholastic achievement of participants in the program of activities was roughly determined from the following data. The pupils' cumulative records showed the percentile ratings determined by the province wide scholastic achievement test administered at the end of the Grade IX year. The distribution of the 27 scores available was as follows:

| Percentile score | Frequency | Percentile score | Frequency |
|---|---|---|---|
| 95-99 | 19 | 45-49 | 0 |
| 90-94 | 0 | 40-44 | 1 |
| 85-89 | 4 | 35-39 | 0 |
| 80-84 | 2 | 30-34 | 0 |
| 75-79 | 0 | 25-29 | 1 |
| 70-74 | 0 | 20-24 | 0 |
| 65-69 | 0 | 15-19 | 0 |
| 60-64 | 0 | 10-14 | 0 |
| 55-59 | 0 | 4-9 | 0 |
| 50-54 | 0 | 0-5 | 0 |

School marks given by teachers at the year end in science subjects taken by 29 of the 32 participants were available from the school records. While the means of the scores for all students in the school in the four science courses were 56, 56, 58 and 58, the distribution of scores for

the 29 science activity participants was as follows:

| Range of score | Frequency |
|---|---|
| 90-100 | 7 |
| 80-89 | 12 |
| 70-79 | 4 |
| 60-69 | 3 |
| 50-59 | 3 |
| 40-49 | 2 |
| 30-39 | 0 |
| 20-29 | 0 |
| 10-19 | 0 |
| 00-09 | 0 |

It appears that with a few exceptions, pupils participating in extracurricular activities in science were high in scholastic achievement and that most of them continued to do very good work during the year of participation in the activities.

## VII. FINDINGS REGARDING SOME PARTICULAR ACTIVITIES AND SOME FEATURES OF SCIENCE CLUB ORGANIZATION

The job of laboratory assistant presented a problem in management. It seemed difficult to make clear that certain privileges extended only to laboratory assistants. Other students not aware of the special position of the laboratory assistants had too frequently to be directed out of the storeroom. Also, the need for help was too irregular to warrant regularly scheduled assistance.

Attendance at business meetings for the last three meetings of the year was approximately half that for the first three meetings of the school year.

Communication of information regarding science club activities to those interested was inadequate.

Some students were enthralled with the prospect of a rocketry project but difficulties presented by lack of qualified supervisors and suitable testing grounds were never overcome.

An attempt made to measure the time spent on each kind of activity by each student failed to yield reliable results. The failure was quite evident at an early stage of operation and the use of the form designed for the purpose was abandoned.

In no case did a large group of students working together succeed in carrying out a science project.

A glance down the columns of Table III will show that there seems to have been very little done to achieve certain objectives. Actions that would bring attention to conservation problems or stimulate interest in recreational activities related to science are notably few.

# CHAPTER IX

## CONCLUSIONS AND RECOMMENDATIONS

Conclusions drawn will be found to follow the same general order as was given the findings in Chapter VIII, but they are separated into two broad classes, and a review is given of those used as evidence in testing the basic hypothesis.

### I. CONCLUSIONS BASED ON RELATIVELY OBJECTIVE INVESTIGATIONS

1. There is not sufficient evidence to conclude that the teachers' ratings of any given objective were different from pupils' ratings of the same objective.

2. There was sound evidence that both teachers and pupils rated the science club objective, "Increased knowledge of scientific facts and principles", higher than the lowest rated objective. Similar evidence showed that both groups rated the following four objectives distinctly lower than the one stated above.

(a) Increased knowledge of scientific vocations.

(b) Increased interest in science as a vocational field.

(c) Increased interest in recreational activities related to science.

(d) Service to others by provision of educational materials and activities.

3. There is not sufficient evidence to conclude that the sponsor's ranking of objectives was related to that of the ten teachers interviewed.

Similarly there was not sufficient evidence to argue that the sponsor's ranking of objectives was related to the composite ranking by

the 36 pupils.

However, there was sufficient evidence to argue that the composite ranking of objectives by the teachers was related to that of the pupils.

4. There was not sufficient evidence to conclude that any two of the three sets of rankings discussed above were more closely related than any other two.

5. Good evidence was found that there is a positive relationship between the sponsor's ranking of the 9 kinds of activities in order of educational value by direct inspection and his ranking by systematic analysis. There was also good evidence of a positive relationship between the sponsor's ranking of the activities by direct inspection and their ranking by the pupils.

Very strong evidence was found indicating a positive relationship between the sponsor's ranking of the activities by systematic analysis and the ranking based on the pupils' estimate of educational value.

6. There is not sufficient evidence to argue that any pair of the three rankings of activities are more closely related to each other than any other pair.

II. CONCLUSIONS BASED ON A MORE SUBJECTIVE TREATMENT OF DATA

7. The values of Q in Table V indicate that there was a good degree of agreement on ratings of individual objectives.

8. Table VII indicates that the objectives established by the sponsor were generally rated as important by both teachers and pupils

and that none were definitely rejected as unsuitable.

9. Projects, the educational program of the Research Council of Alberta, and the special physics lectures appear to have made the greatest contribution to the achievement of objectives of the science club. The business meetings appear to have contributed less in a direct way to the objectives than any other activity.

10. The educational program carried on under the instruction of scientists of the Research Council of Alberta seems to have a potential that was far from being fully realized under the plan of operation followed during the school year 1959-60.

11. The special physics lectures aroused the good amount of interest and enthusiasm that was expected and stimulated other activities in the area of physics.

12. There are indications that pupils that have experienced science activities during 1959-60 intend to participate to a greater extent than ever during the year 1960-61.

13. The 1959-60 participants generally seem to think their parents are in favor of their participation in extracurricular activities in science.

14. The participants showed a tendency to prefer those activities for which educational value as estimated in this study was relatively high.

15. The students participating in the program of extracurricular

activities in science during the year 1959-60 were generally of high scholastic achievement.

## III. CONCLUSION REGARDING THE BASIC HYPOTHESIS

The basic hypothesis, "that a carefully planned program of extra-curricular activities in science for students of the Strathcona Composite High School will have enough educational value to warrant its continuation," is in the main, supported by the evidence reviewed above.

The suitability of the 14 objectives as criteria of success is supported by the authorities from which they were derived, by good agreement of pupils and teachers in placing the objectives generally high in importance, and by the absence of distinct rejection of any objective.

Evidence that there was some degree of achievement of these objectives is found in the following:

(a) Agreement of results from the three ways of estimating educational values of the nine kinds of activities increases confidence in the validity of the estimates.

(b) There is a tendency of students to take part in those activities which seem to have the highest educational value.

(c) Confidence in the worth of the activities was expressed by participating students, teachers, and scientists.

It will be noted that while the evidence available does tend to support the basic hypothesis it is lacking in objectivity. It would seem that the approach to evaluation used in this thesis is much more suited to providing guidance for the development of a program than it is to providing highly objective evidence regarding its value.

## IV. RECOMMENDATIONS CONCERNING THE OPERATION OF THE SCIENCE CLUB OF THE STRATHCONA COMPOSITE HIGH SCHOOL

1. The science club of the Strathcona Composite High School should continue to operate but with the modifications suggested in this list of recommendations.

2. The list of objectives established should be used as a basis for action and for further study. It should be modified slightly by subdividing very highly rated objectives and combining those that appear to be of lesser importance.

3. More confidence should be placed in the judgment of the science club members. Their influence should be extended over all extracurricular activities in science as far as is practicable.

4. The science club organization should allow for more planning by its executive and executive committees in order to greatly reduce the time required for business meetings.

5. The science club should continue to extend its assistance with projects and opportunities to display them to all pupils of the school regardless of grade or scholastic standing.

6. The educational program with the Research Council of Alberta should be continued but modified to give more consideration to the problem of selection of student participants and to the interests of individual students.

7. Participation in the special physics lectures should be continued. The planning of this program is not in the hands of the science club or the sponsor but some influence might be exerted.

8. The sponsor must budget his time spent on science club activities more closely under the pressure of an expanding program. Four hours per week would seem reasonable in view of past experience and predicted membership and activity.

9. An effort should be made to give attention to all major fields of science. Since the sponsor is a physics teacher he must guard against drawing all talent into projects in physics. Assistance from other teachers and reference persons should offset this tendency.

10. The plan for laboratory assistance should be changed completely to one where assistance is obtained only when it is needed for a specific job.

11. A very deliberate effort should be made to make the best use of all advertising and communication mediums within the school.

12. In order to move toward a more balanced program attention should be given to the achievement of those objectives that appeared to be most neglected during the past year.

13. Future use of the forms of evaluation used in this study should be as follows:

(a) A new method of recording extent of student participation should be devised to take the place of the one rejected.

(b) The proportion of time and effort given to evaluation of objectives should be greatly reduced.

(c) All other evaluation devices should be modified in the light of experience and continue in use.

## V. GENERAL RECOMMENDATIONS

1. Two distinct kinds of investigation should be carried on in order to extend knowledge of extracurricular activities in science.

Some investigations, following along the lines of this study, should be long continuing developmental processes guided by the best information sources and evaluation procedures available. These studies are likely to yield satisfying results to the on-the-job researchers who capably combine the necessary art with the science that is applicable.

Other research should use rigorous methods to measure extent of achievement of properly established goals and thereby seek more substantial evidence regarding the value of particular extracurricular activities in science.

2. The development of extracurricular activities in science should remain firmly under the control of school authorities in order to facilitate growth of properly integrated programs.

3. In order to secure enthusiastic leadership for activities in science, all teacher participation should be on a voluntary basis with possible recognition for time and effort expended.

4. Since development of a good activity to suit local conditions is

often a slow process requiring much investigation, provision should be made for communication of experience among neighboring high school science clubs.

5. The policy of starting activity in a science club on a small scale and expanding it in the light of experience gained is strongly recommended.

6. Science club sponsors should seek to develop balanced programs consisting of a variety of activities and should not allow the life of the club to become dependent on one activity or project.

7. The objectives established, the evaluation procedures used, and the activities discussed in this thesis are recommended for consideration by science club sponsors seeking to develop programs of extracurricular activities in science.

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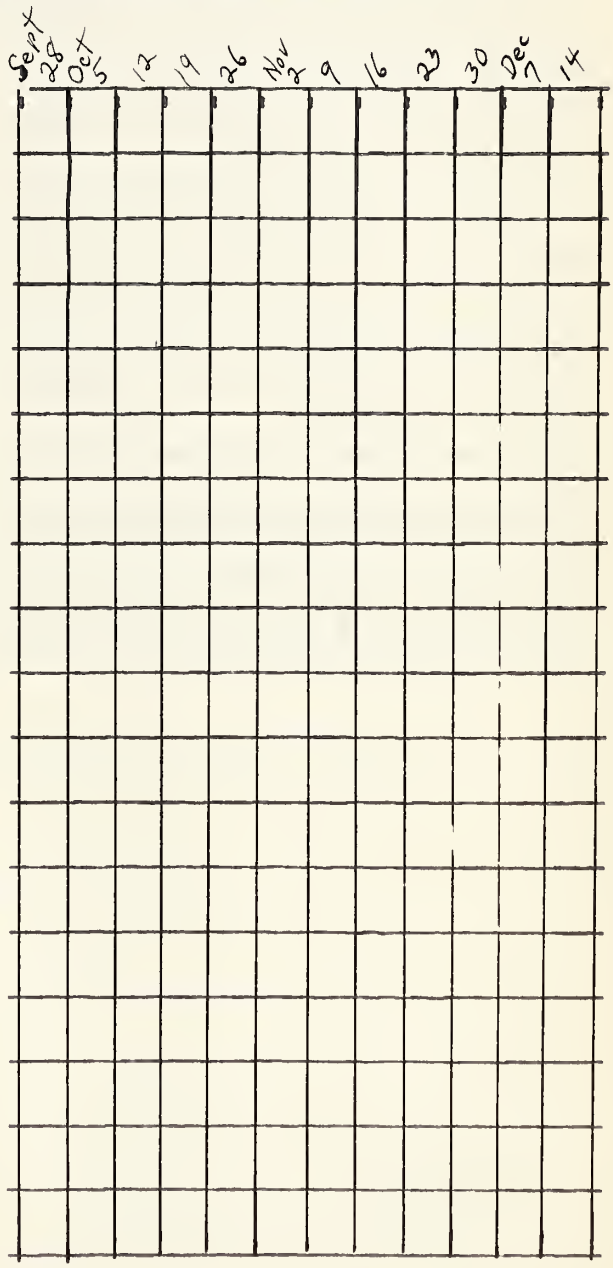
# APPENDICES

APPENDIX A

NAME OF MEMBER _____

WEEKLY RECORD OF PARTICIPATION IN SCIENCE CLUB ACTIVITIES

Write in the number of minutes spent since the last entry and up to but not including the date listed above the entry being made.




Collections of scientific interest

Photography of scientific interest

Construction or testing of Science Club equipment

Research (experiment and investigation)

Trips to industrial plants and laboratories

Trips to libraries

Participation in A.R.C. research

Trips for nature study

Trips to the University of Alberta

Observing other members at work on projects

Viewing films

Reading resulting from Science Club activity

Participation or listening to debates or discussions on chosen topics

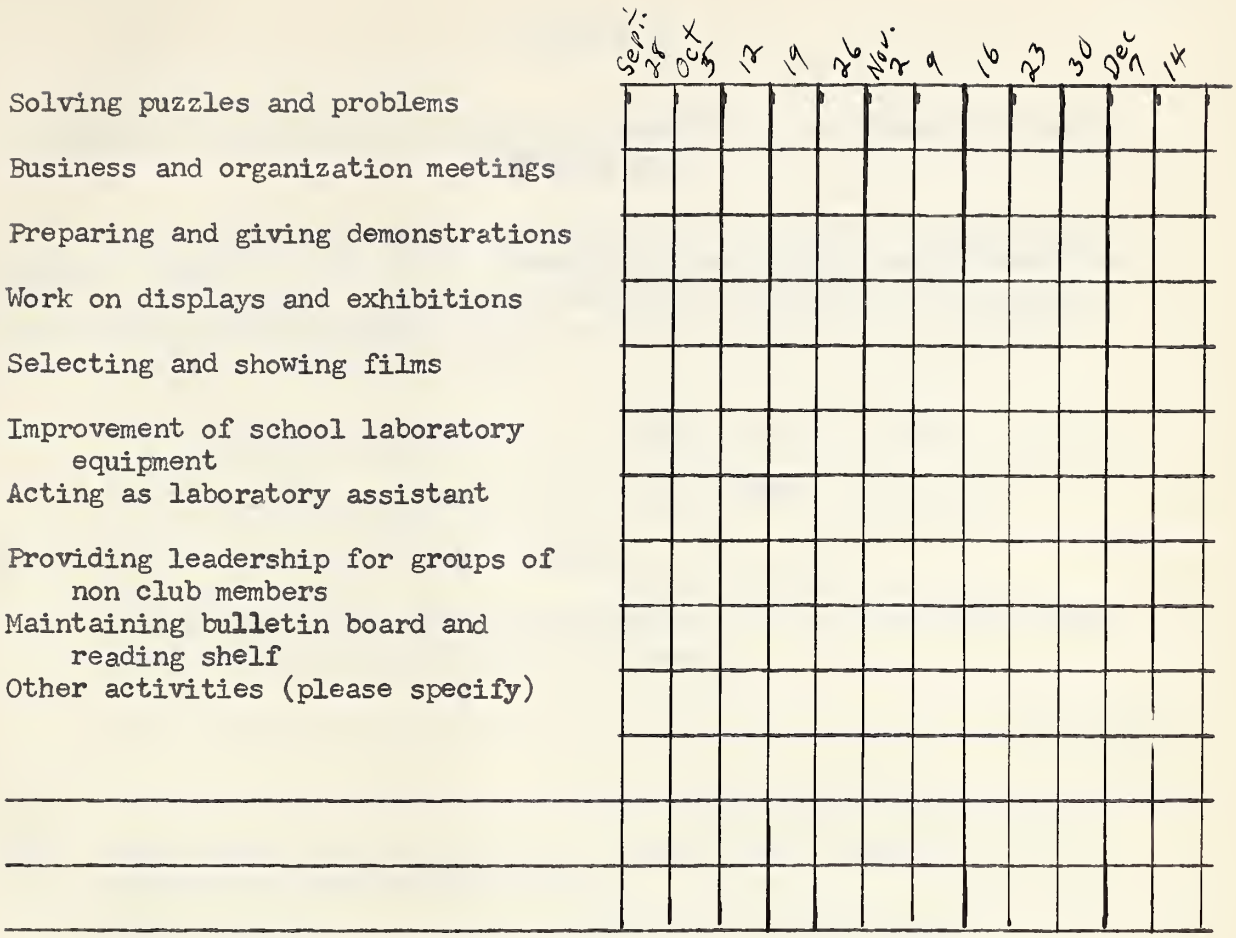
Hearing reports on adult science organizations

Hearing special reports on the activities of club members

Hearing visiting speakers

Psychological testing

Mathematical games


Sept. 28
Oct 5
12
19
26
Nov. 2
9
16
23
30
Dec 7
14
Solving puzzles and problems
Business and organization meetings
Preparing and giving demonstrations
Work on displays and exhibitions
Selecting and showing films
Improvement of school laboratory equipment
Acting as laboratory assistant
Providing leadership for groups of non club members
Maintaining bulletin board and reading shelf
Other activities (please specify)

# APPENDIX B

## TO STUDENTS PARTICIPATING IN RESEARCH PROJECTS AT THE RESEARCH COUNCIL OF ALBERTA

The purpose of this questionnaire is to evaluate the activities you have engaged in and not to investigate individual participants. You will be of assistance to those who plan such activities if you answer the following questions with the honesty and objectivity that are characteristic of scientific work.

I. Name _____ Sex _____ Age _____

School _____ Grade _____

II. How many meetings did you attend? _____

If you were absent from some meetings held by your group please indicate the reasons for such absences.

_____

_____

III. Considering your own welfare, do you think the amount of time you spent on this activity was:

(a) too great _____ (b) too little _____ just right _____

IV. What do you think of the balance between theoretical and experimental work done?

(a) Too much theoretical work _____

(b) Too much experimental work _____

(c) Balance about right _____

V. What influence has this educational experience had upon your activity so far and how has it affected decisions regarding your future?

VI. You are invited to comment on any points related to the the above questions and to make suggestions as to how the program could be improved in order to make it of greater value to people like yourself.

# APPENDIX C

## INTERVIEW QUESTIONS ASKED TEACHERS WHO PARTICIPATED IN THE RESEARCH COUNCIL PROGRAM

1. Now that we have completed one year's activity and look forward, which of the following do you think should be done?

   (a) Continue the project in its present form. _____

   (b) Continue the project but modify it considerably. _____

   (c) Discontinue the project. _____

2. What did you think of the balance between theoretical and experimental work?

   (a) Too much theoretical work. _____

   (b) Too much experimental work. _____

   (c) Balance about right. _____

3. What modifications of the project do you suggest?

   _____

   _____

# APPENDIX D

## A Questionnaire to Evaluate the University of Alberta Evening Classes in Physics for Selected High School Students

"An Introduction to Theoretical Physics"

Wednesday, March 16th, 1960

The purpose of this questionnaire is to evaluate the activities which you have engaged in and not to investigate individual participants. You will be of assistance to those who plan such activities if you answer the following questions with the honesty and objectivity that are characteristic of scientific work.

I. Name _____ Sex _____ Age _____

Birth Date _____ School _____ Grade ___

II. (a) Do you plan to attend University? _____

(b) Have you decided upon a field of study, and if so what field? _____

III. (a) How many of the 10 lectures in the series did you attend? _____

(b) If you were absent from some of the lectures please indicate the reasons for such absences.

_____

_____

IV. (a) Considering your own welfare, do you think the amount of time spent on this activity this year was:

(i) too great _____ (ii) just right _____ (iii) too little ___

(b) In your opinion, was the amount of mathematics used in the lectures:

(i) too much _____ (ii) just right _____ (iii) too little___

V. State the nature and extent of activities on your part which were the direct result of your participation in these lectures. (e.g. related reading, books purchased, experiments done, discussions, etc.)

_____

_____

_____

_____

VI. Do you think that the experience gained from attending these lectures has given you a substantially better basis for making wise decisions regarding your plans for the future? _____

VII. You are invited to comment on the lecture series and to make suggestions as to how the programme could be improved to make it of greater value to people like yourself.

_____

_____

_____

_____

_____

_____

_____

_____

_____

# APPENDIX E

## INTERVIEW QUESTIONS ASKED PUPILS WHO PARTICIPATED IN EXTRACURRICULAR ACTIVITIES IN SCIENCE

1. In which of the following science activities have you participated this year?

   (a) Projects
   (b) Field trips
   (c) Viewing films
   (d) Science fair
   (e) Use of reading shelf
   (f) Special physics lectures
   (g) Research Council Program
   (h) Laboratory assistance
   (i) Business meetings

2. Indicate your order of preference among those activities you took part in. Consider their value to you.

3. Which of the above activities do you wish to take part in next year?

4. Indicate your first three choices from the selected in No. 3 above.

5. What suggestions have you for other activities that might be promoted?

6. How much time do you expect to spend in science club activity next year?

   (a) None _____
   (b) Less than this year _____
   (c) Same as this year _____
   (d) More than this year _____

7. What is your parents' attitude toward your participation in science club activity?

(a) Strongly disapprove _____

(b) Disapprove _____

(c) Indifferent _____

(d) Approve _____

(e) Strongly approve _____

# APPENDIX F

## OBJECTIVES OF THE SCIENCE CLUB

IMPROVED SCHOLARSHIP IN SCIENCE

1. Increased knowledge of scientific facts and principles.
2. Increased knowledge of scientific vocations.
3. Increased familiarity with scientific method.
4. Increased laboratory skills.
5. Increased desire for scholastic achievement.
6. Increased resourcefulness.
7. Increased tendency to search for the truth with an open mind.

INCREASED INTEREST IN SCIENCE

8. Increased interest in reading material in the field of science.
9. Increased interest in science as a vocational field.
10. Increased interest in recreational activities related to science.
11. Increased tendency to associate with others with science interest.
12. Broadening of interests to more areas of science.

SERVICE TO OTHERS

13. By provision of educational materials and activities.
14. By attention to matters relating to conservation of resources.

# APPENDIX G

## FORM USED IN CONJUNCTION WITH APPENDIX E

## FOR THE PURPOSE OF RATING OBJECTIVES

(This form was used by both teachers and students who rated the objectives).

Oral instruction given was:

"Place a check mark in the appropriate column to indicate the degree of importance you attach to each of the objectives listed on the separate sheet. Note that the numbers at the left represent the 14 objectives on the list."

| Objective Number | Should not be Considered | Is Unimportant | Deserves Consideration | Is Important | Is very Important |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |

# APPENDIX H

## ASSISTANCE TO THE SCIENCE CLUB

The Science Club of the Strathcona Composite High School would be very grateful for contributions that will help it achieve its aims of improved scholastic achievement, increased interest in science, and service to others who are learning about science.

The following list describes some of our needs.

1. Discarded equipment of use in science projects.

2. Opportunities for guided tours of scientific interest.

3. Visiting speakers to speak at noon hour to groups of interested students on science topics.

4. Opportunities for a few outstanding students to observe laboratory or research procedures.

5. Films (16 mm.) on science topics. They must be interesting enough to draw a noon hour audience, yet have enough educational value to make them worth-while.

6. Literature on scientific equipment and processes in our locality as well as samples and illustrations suitable for a museum of local industry.

7. Financial assistance.

8. Any other form of assistance that seems appropriate.

Concerning contributions please contact

J. E. Kruger, (Science teacher)
11828 75 Avenue,
Edmonton.

Phone GE9-2622

# APPENDIX I

## SCIENCE DISPLAY - APRIL 13, 1960

## DIRECTORY

(See back of this sheet for floor plan)

ROOM 104 (Time to be announced)
The Van der Graaf Generator.
A winning project by Ralph Christian and Ted Reimchen.

***** *****

ROOM 108 (Time to be announced)
Measurement of Acceleration.
A winning project by Richard Toogood.

***** *****

ROOM 116 (Time to be announced)
A Study of Variable Stars - by Robert Allin.

***** *****

ROOM 106 (Continuous)
Regular Laboratory Demonstrations in Physics and Chemistry.

***** *****

ROOM 110 (Continuous)
Biology Projects and Materials.

***** *****

ROOM 112 (Continuous)
Some Projects in Physics.
Hilsch Tube, Rocketry, Thermocouple, Cloud Chamber.

***** *****

ROOM 115 (Continuous)
Science Magic - Some scientific puzzles and illusions.

***** *****

The President of the Science Club, Kenneth Dubeta, will announce times of talks given in Rooms 104, 108 and 116.

B29788